

# Marine Fish and Invertebrate Atlas: Summarizing Geographic Distribution and Population Indices in the Scotian Shelf and Bay of Fundy (1970-2020)

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6 MARINE FISH AND INVERTEBRATE ATLAS: SUMMARIZING GEOGRAPHIC DISTRIBUTION,  
7 POPULATION INDICES AND ENVIRONMENTAL PREFERENCES IN THE SCOTIAN SHELF  
8 AND BAY OF FUNDY (1970-2020)

by

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## ABSTRACT

166 Ricard, D., Gomez, C., Emberley, J. and Regnier-McKellar, C. 2021. Marine Fish and Invertebrate  
167 Atlas: Summarizing Geographic Distribution, Population Indices and Environmental  
168 Preferences in the Scotian Shelf and Bay of Fundy (1970-2020). Can. Tech. Rep. Fish. Aquat.  
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170 The summer groundfish research vessel survey on the Scotian Shelf and in the Bay of  
171 Fundy started in 1970 and was designed to measure the distribution and abundance of  
172 major commercial fish species. Over time, additional information on non-commercial species  
173 was collected, and allowed considerable insight into ecosystem function and structure, as  
174 documented in many primary publications whose analyses used the survey data. The same  
175 groundfish survey database has also been used to produce species status reports, atlases of  
176 species distribution and remains an essential source of information for stock assessments in the  
177 Maritimes Region of Fisheries and Oceans Canada. This report builds on previous work and  
178 former atlases by updating a comprehensive suite of indices to assess population status and  
179 environmental preferences of 104 species. For each species, trends in geographic distribution  
180 and biomass or abundance were plotted. The spatial extent of distribution was plotted over  
181 time to gauge how the area occupied has changed. The relationship between abundance or  
182 biomass and spatial extent reflected whether the species distribution expands when abundance  
183 or biomass increases. Length frequencies over time depicted any changes in mean size. The  
184 plots of condition over time revealed whether individual fish are fatter or thinner than their long  
185 term mean. Depth, temperature and salinity preferences were estimated to gauge the range  
186 of suitable environmental parameters for each species. Finally, for each stratum, the slope  
187 describing how local density varies with regional abundance was estimated.

## RÉSUMÉ

189 Ricard, D., Gomez, C., Emberley, J. and Regnier-McKellar, C. 2021. Marine Fish and Invertebrate  
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193 Le relevé estival par navires de recherche sur le poisson de fond sur le plateau néo-écossais  
194 et dans la baie de Fundy a débuté en 1970 et visait à mesurer la répartition et l'abondance  
195 des principales espèces de poissons commerciales. Au fil du temps, des informations  
196 supplémentaires sur les espèces non commerciales ont été recueillies et ont permis de mieux  
197 comprendre la fonction et la structure de l'écosystème, comme le montrent de nombreuses  
198 publications primaires dont les analyses ont utilisé les données des relevés. La même base  
199 de données sur les relevés du poisson de fond a également été utilisée pour produire des  
200 rapports sur la situation des espèces, des atlas de la répartition des espèces et demeure une  
201 source essentielle d'information pour les évaluations des stocks dans la région des Maritimes  
202 de Pêches et Océans Canada. Ce rapport s'appuie sur des travaux antérieurs et d'anciens  
203 atlas en mettant à jour une série complète d'indices pour évaluer l'état de la population et les  
204 préférences environnementales de 104 espèces. Pour chaque espèce, les tendances de la  
205 répartition géographique et de la biomasse ou de l'abondance ont été tracées. L'étendue spatiale  
206 de la distribution a été tracée au fil du temps pour évaluer comment la zone occupée a changé.  
207 La relation entre l'abondance ou la biomasse et l'étendue spatiale indique si la répartition des  
208 espèces augmente lorsque l'abondance ou la biomasse augmente. Les fréquences de longueur  
209 au fil du temps représentaient tout changement dans la taille moyenne. Les graphiques de l'état  
210 au fil du temps ont révélé si les poissons individuels sont plus gros ou plus minces que leur  
211 moyenne à long terme. Les préférences en matière de profondeur, de température et de salinité  
212 ont été estimées pour évaluer la gamme de paramètres environnementaux appropriés pour  
213 chaque espèce. Enfin, pour chaque strate, la pente décrivant comment la densité locale varie  
214 avec l'abondance régionale a été estimée.

215

## 1 Introduction

216 The summer (July-August) groundfish research vessel survey on the Scotian Shelf and in the  
217 Bay of Fundy was started in 1970 by Fisheries and Oceans Canada Maritimes Region. The  
218 survey was originally designed to measure the distribution and abundance of major commercial  
219 fish species. Over time, information on non-commercial species was also collected. The  
220 groundfish survey database storing the information collected during the annual survey provides  
221 the main source of fisheries-independent information for marine species in the region. This  
222 information is routinely used to support stock assessments, to produce species status reports  
223 and has been previously used to publish atlases of species distribution.

224 The current document is an update of an earlier report (Ricard and Shackell 2013) that built  
225 on former atlases by updating a comprehensive suite of derived indices for 104 species to  
226 assess population status and, when feasible, environmental preferences. The information  
227 collected during the survey is stored in a relational database management system archived  
228 at Fisheries and Oceans Canada Maritimes Region which contains detailed information about  
229 the sampling locations and the associated catch. Tow-level survey data is also publicly available  
230 from the Ocean Biogeographic Information System (DFO 2016) and from the Open data portal  
231 supported by the federal government (DFO 2021). The present atlas builds upon the work done  
232 by Fisheries and Oceans colleagues from the northern Gulf of St. Lawrence (Bourdages and  
233 Ouellet 2012), southern Gulf of St. Lawrence (Benoît et al. 2003) and on earlier work in the  
234 Scotian Shelf (Simon and Comeau 1994; Horsman and Shackell 2009).

235 To facilitate updates and foster collaboration on the analyses of the survey data, the computer  
236 code necessary to extract the data, to perform the analyses presented herein, and to reproduce  
237 and update the current document is made available in a git repository (Ricard and Gomez 2021).

238 The survey area covers three major Northwest Atlantic Fisheries Organization (NAFO) zones  
239 that divide the Scotian Shelf into the colder east 4V and 4W (strata 440-466) and warmer  
240 west 4X (strata 470-495). For each species, temporal trends in geographic distribution and,  
241 when possible, biomass are plotted. Some caution is required in interpreting the results  
242 obtained for several taxa due to low sample size as explained later in the text. A full ecological  
243 interpretation of trends is beyond the scope of this report. Other documents stemming from peer-  
244 reviewed scientific processes under the auspices of the [Canadian Science Advisory Secretariat](#)  
245 (CSAS) provide further descriptions of spatio-temporal trends in different indicators and put the  
246 information collected during the summer groundfish research vessel survey in a more focused  
247 context (see for example Clark and Emberley (2011)).

248

## 2 Methods

### 249 2.1 Survey Description

250 The survey is conducted annually in July-August and covers the Scotian Shelf and the Bay of  
251 Fundy (Figure 2). It normally involves two separate two-week trips on board an offshore fisheries  
252 vessel from the Canadian Coast Guard.

253 A number of changes in fishing gear type and vessels used occurred since the onset of sampling  
254 activities (Clark and Emberley 2011). Comparative fishing experiments were conducted when  
255 those changes in survey platforms took place. A timeline of the survey platforms can be found in  
256 Figure 1.

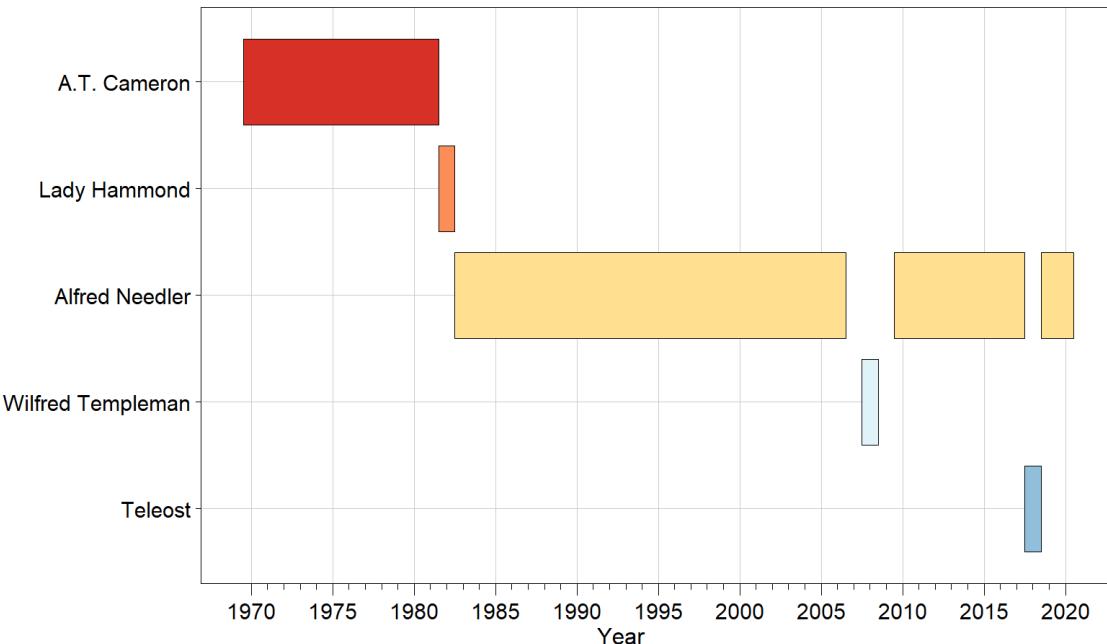


Figure 1. Timeline of vessels and gears used in the Maritimes Region summer survey.  
Comparative fishing experiments are indicated by gray bars linking two fishing platforms.

## 257 2.2 Sampling Design

258 The summer survey covers divisions 4V, 4W and 4X of the Northwest Atlantic Fisheries  
259 Organization (NAFO) which includes the Scotian Shelf and the Bay of Fundy. The eastern limit of  
260 the survey is the Laurentian Channel and the western limit is the Fundian Channel (Figure 2).

261 The survey follows a stratified random design (Doubleday and Rivard 1981; Lohr 1999)  
262 (Figure 3). The number of tows conducted in each stratum is approximately proportional to the  
263 surface area of the stratum. The targeted area covered by the survey has remained constant  
264 since its inception, with the exception of additional deeper strata that were only sampled a few  
265 times since 2000. Because the sampling of the deeper strata is opportunistic and irregular, the  
266 analyses presented herein only include strata 440 to 495 which cover NAFO Divisions 4V, 4W  
267 and 4X (Figure 3 and Table 1).

268 The basic sampling unit of the survey is a 30-minute fishing tow conducted at a speed of 3.5  
269 knots. This yields a distance towed of 1.75 nautical miles.

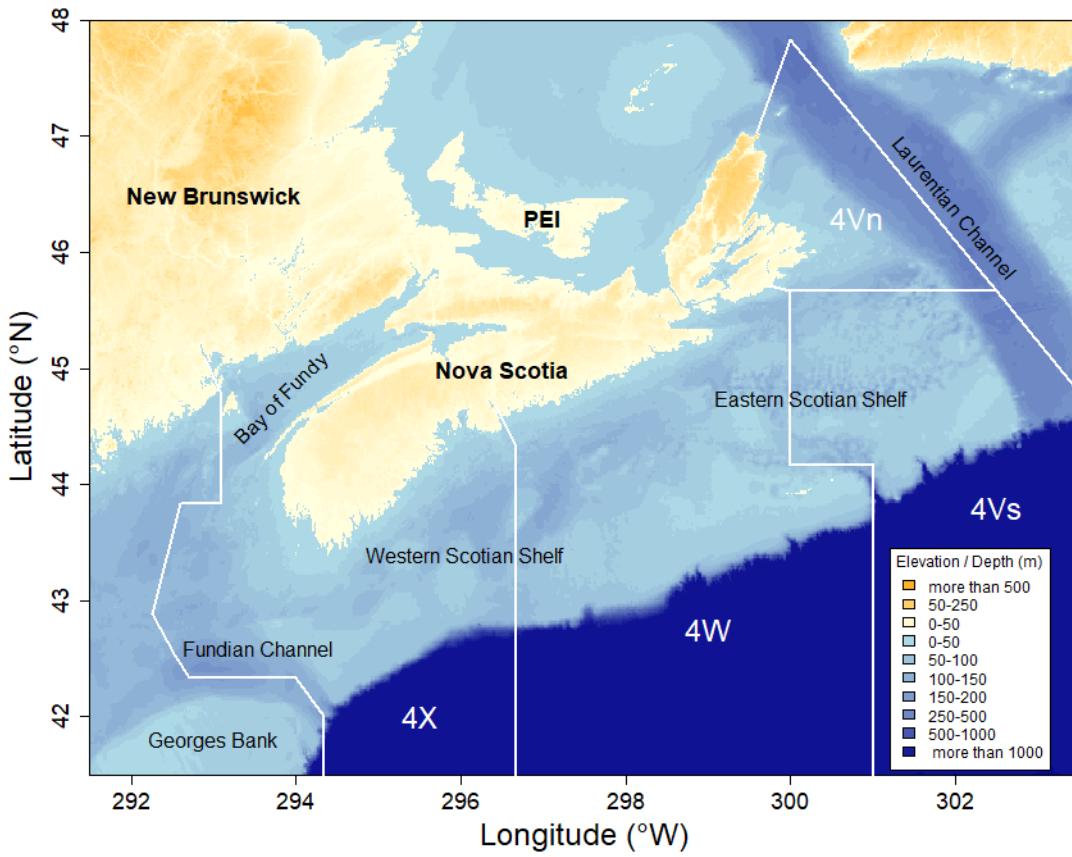


Figure 2. Map of the Scotian Shelf and Bay of Fundy where the DFO Maritimes summer survey takes place. The bathymetry presented here is the 15 arc-second gridded data set from the General Bathymetric Chart of the Oceans ([GEBCO](#)). Geographical locations of interest and the boundaries of relevant NAFO Divisions are also shown on the map.

Table 1. Summer survey strata details. The strata used in the analyses are presented separately for NAFO Divisions 4Vn, 4VsW and 4X. For each stratum, the depth range in fathoms and the surface area in square kilometers are reported.

NAFO Div.	Stratum	Depth range (fathom)	Area (km <sup>2</sup> )
4Vn	440	101-200	924
	441	51-100	1000
	442	11-49	1437

<b>NAFO Div.</b>	<b>Stratum</b>	<b>Depth range (fathom)</b>	<b>Area (km<sup>2</sup>)</b>
4VsW	443	11-49	1318
	444	51-100	3925
	445	101-200	1023
	446	101-200	491
	447	11-49	1616
	448	11-49	1449
	449	51-100	144
	450	51-100	383
	451	101-200	147
	452	101-200	345
	453	101-200	259
	454	51-100	499
	455	11-49	2122
	456	11-49	955
	457	51-100	811
	458	11-49	658
	459	11-200	3148
	460	51-100	1344
	461	101-200	1154
	462	51-100	2116
	463	11-49	302
	464	11-50	1297
	465	51-100	2383
	466	101-200	226

NAFO Div.	Stratum	Depth range (fathom)	Area (km <sup>2</sup> )
4X	470	51-100	920
	471	101-200	1004
	472	51-100	1249
	473	11-49	265
	474	11-49	161
	475	11-49	156
	476	51-100	1478
	477	51-100	1232
	478	101-200	233
	480	11-49	655
	481	51-100	1875
	482	101-200	1042
	483	101-200	532
	484	101-200	2264
	485	51-100	1582
	490	11-49	601
	491	51-100	687
	492	51-100	1086
	493	11-49	533
	494	11-49	417
	495	11-49	584

270 After each tow the catch is sorted by species and weighed. Each fish caught is then measured,  
 271 and further sampling of individual fish weight, maturity status and age are performed for different  
 272 length classes. When catches exceed 300 individuals, a random sub-sample is used to obtain  
 273 the length and weight measurements.

### 274 2.3 Taxonomic Levels

275 Fish species caught during the surveys are identified by trained scientific personnel and their  
 276 scientific name is determined. An internal species code used in the relational database is  
 277 reported for each species (Losier and Waite 1989).

278 By its nature as a bottom trawl, the fishing gear used in the survey catches certain species  
 279 better than others. To ensure that meaningful ecological information can be extracted from  
 280 catch samples, we report the catch records for the subset of species that are caught reliably  
 281 by the gear. To appear in this atlas, a species must have had a minimum of 10 observations over  
 282 the duration of the survey activities. While both catch abundance and weight are recorded, the  
 283 weight of species that appear at low abundances is often recorded as zero in the earlier parts of  
 284 the survey when scales of appropriate precision were not available.

285 We divided the species caught into five categories based on 1) their taxonomic classification,

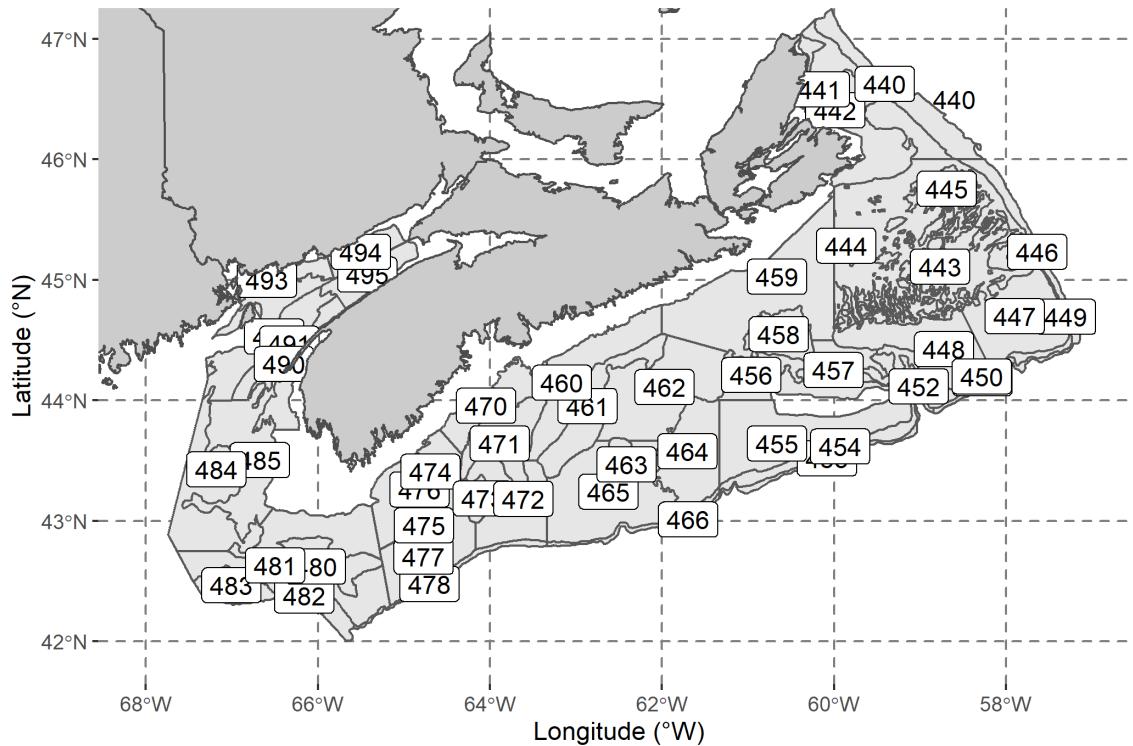


Figure 3. Map of the summer survey strata 440 to 495.

286 2) the number of recorded observations, and 3) their period of valid identification (Table 2).  
 287 Category "LF", for "long frequent", was assigned to species that have more than 1000 records  
 288 since 1970 and have been consistently identified since the onset of the survey. Category  
 289 "LI", for "long intermediate", was assigned to species that had between 1000 and 200 catch  
 290 records. Rare and elusive species (those with less than 200 catch records over the duration  
 291 of the survey) are also reported but to a lower level of analytical details (Category "LR", for  
 292 "long rare"). Category "SF", for "short frequent", was assigned to invertebrate species that were  
 293 consistently sampled only since 1999 (Tremblay M. J. 2007). And category "SR", for "short rare"  
 294 for invertebrate species consistently sampled only since 1999 and with less than 200 catch  
 295 records. To ensure concordance with authoritative taxonomic information, the AphiaID from the  
 296 World Register of Marine Species (Appeltans et al. 2012) is included for the different species  
 297 presented in this document (Table 3) .

Table 2. Taxonomic levels used to determine the analytical treatment for each species.

<b>Category</b>	<b>Name</b>	<b>Description</b>
L	long - consistently identified since the onset of the survey in 1970	
LF	long frequent	species that have more than 1000 catch records
LI	long intermediate	species that had between 1000 and 200 catch records
LR	long rare	species with less than 200 catch records
S	short - invertebrate species that were consistently sampled only since 1999	
SF	short frequent	species with more than 200 catch records
SR	short rare	species with less than 200 catch records

Table 3. List of species included in the Atlas. For each taxonomic order and class, each species is listed in the table, its taxonomic family and scientific name is provided, along with its French and English common names, the species code used in the survey database, its AphiaID with a link to the World Registry of Marine Species, its number of catch records in the survey database and its classification category as defined in section 2.3.

	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
<b>Actinopterygii</b>								
<i>Anguilliformes</i>								
	Nemichthyidae	<i>Nemichthys scolopaceus</i>	Slender snipe eel	Avocette ruban	604	<a href="#">126306</a>	28	LR
<i>Argentiniformes</i>								
	Argentinidae	<i>Argentina silus</i>	Greater argentine	Grande argentine	160	<a href="#">126715</a>	963	LI
<i>Aulopiformes</i>								
	Chlorophthalmidae	<i>Chlorophthalmus agassizi</i>	Shortnose greeneye	Éperlan du large	156	<a href="#">126336</a>	78	LR
		<i>Parasudis truculenta</i>	Longnose greeneye	Oeil-vert à long nez	149	<a href="#">158868</a>	45	LR
	Paralepididae	<i>Arctozenus risso</i>	White barracudina	Lussion blanc	712	<a href="#">126352</a>	196	LR
<i>Beloniformes</i>								
	Scomberesocidae	<i>Scomberesox saurus</i>	Atlantic saury	Balaou atlantique	720	<a href="#">126392</a>	37	LR
<i>Clupeiformes</i>								
	Clupeidae	<i>Alosa pseudoharengus</i>	Alewife	Gaspareau	62	<a href="#">158669</a>	977	LI
		<i>Alosa sapidissima</i>	American shad	Alose savoureuse	61	<a href="#">158670</a>	468	LI
		<i>Clupea harengus</i>	Atlantic herring	Hareng de l'Atlantique	60	<a href="#">126417</a>	3487	LF
<i>Gadiformes</i>								
	Gadidae	<i>Gadus morhua</i>	Atlantic cod	Morue franche	10	<a href="#">126436</a>	5451	LF
		<i>Melanogrammus aeglefinus</i>	Haddock	Aiglefin	11	<a href="#">126437</a>	5827	LF
		<i>Microgadus tomcod</i>	Atlantic tomcod	Poulamon atlantique	17	<a href="#">158928</a>	44	LR
		<i>Pollachius virens</i>	Pollock	Goberge	16	<a href="#">126441</a>	2787	LF
	Lotidae	<i>Brosme brosme</i>	Cusk	Brosme	15	<a href="#">126447</a>	688	LI

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Perciformes	Macrouridae		<i>Enchelyopus cimbricus</i>	Fourbeard rockling	Motelle à quatre barbillons	114	<a href="#">126450</a>	693	LI
			<i>Coryphaenoides rupestris</i>	Roundnose grenadier	Grenadier de roche	414	<a href="#">158960</a>	17	LR
			<i>Nezumia bairdii</i>	Marlin-spike grenadier	Grenadier du Grand Banc	410	<a href="#">183289</a>	529	LI
			<i>Trachyrincus murrayi</i>	Roughnose grenadier	Grenadier-scie	412	<a href="#">126481</a>	18	LR
	Merlucciidae		<i>Merluccius albidus</i>	Offshore silver hake	Merlu argenté du large	19	<a href="#">158748</a>	161	LR
			<i>Merluccius bilinearis</i>	Silver hake	Merlu argenté	14	<a href="#">158962</a>	4936	LF
	Phycidae		<i>Phycis chesteri</i>	Longfin hake	Merluche à longues nageoires	112	<a href="#">158988</a>	784	LI
			<i>Urophycis chuss</i>	Red hake	Merluche écureuil	13	<a href="#">126503</a>	2195	LF
			<i>Urophycis tenuis</i>	White hake	Merluche blanche	12	<a href="#">126504</a>	3524	LF
<i>Lophiiformes</i>	Lophiidae	<i>Lophius americanus</i>	Monkfish	Baudroie d'Amérique	400	<a href="#">159184</a>	1970	LF	
	Ogcocephalidae	<i>Dibranchus atlanticus</i>	Atlantic batfish	Malthe atlantique	742	<a href="#">126558</a>	18	LR	
	Myctophidae	<i>Myctophidae</i>	Lanternfishes	Poissons-lanternes	150	<a href="#">125498</a>	160	LR	
<i>Osmeriformes</i>	Osmeridae		<i>Mallotus villosus</i>	Capelin	Capelan	64	<a href="#">126735</a>	540	LI
			<i>Osmerus mordax</i>	Rainbow smelt	Éperlan arc-en-ciel	63	<a href="#">126737</a>	59	LR
	Ammodytidae	<i>Ammodytes dubius</i>	Sand lance	Lançon	610	<a href="#">151520</a>	1283	LI	
<i>Anarhichadidae</i>			<i>Anarhichas denticulatus</i>	Northern wolffish	Loup à tête large	52	<a href="#">126757</a>	17	LR
			<i>Anarhichas lupus</i>	Atlantic wolffish	Loup atlantique	50	<a href="#">126758</a>	1572	LF

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
			<i>Anarhichas minor</i>	Spotted wolffish	Loup tacheté	51	<a href="#">126759</a>	20	LR
		Callionymidae	<i>Foetorepus agassizii</i>	Spotfin dragonet	Dragonnet tacheté	637	<a href="#">276339</a>	20	LR
		Cryptacanthodidae	<i>Cryptacanthodes maculatus</i>	Wrymouth	Terrassier tacheté	630	<a href="#">159675</a>	120	LR
		Labridae	<i>Tautogolabrus adspersus</i>	Cunner	Tanche-tautogue	122	<a href="#">159785</a>	82	LR
		Pholidae	<i>Pholis gunnellus</i>	Rock gunnel	Sigouine de roche	621	<a href="#">126996</a>	21	LR
		Scombridae	<i>Scomber scombrus</i>	Atlantic mackerel	Maquereau commun	70	<a href="#">127023</a>	696	LI
		Stichaeidae	<i>Eumesogrammus praecisus</i>	Fourline snakeblenny	Quatre-lignes atlantique	626	<a href="#">159817</a>	40	LR
			<i>Leptoclinus maculatus</i>	Daubed shanny	Lompénie tachetée	623	<a href="#">127072</a>	443	LI
			<i>Lumpenus lampretaeformis</i>	Snakeblenny	Lompénie-serpent	622	<a href="#">154675</a>	423	LI
			<i>Ulvaria subbifurcata</i>	Radiated shanny	Ulvaire deux-lignes	625	<a href="#">159821</a>	145	LR
		Stromateidae	<i>Peprilus triacanthus</i>	Atlantic butterfish	Stromaté fossette	701	<a href="#">159828</a>	487	LI
		Zoarcidae	<i>Lycenchelys verrillii</i>	Wolf eelpout	Lycode à tête longue	603	<a href="#">159258</a>	40	LR
			<i>Lycodes lavalaei</i>	Newfoundland eelpout	Lycode du Labrador	620	<a href="#">127107</a>	72	LR
			<i>Lycodes reticulatus</i>	Arctic eelpout	Lycode arctique	641	<a href="#">127112</a>	70	LR
			<i>Lycodes terraenovae</i>	Newfoundland eelpout	Lycode du Labrador	619	<a href="#">127117</a>	64	LR
			<i>Lycodes vahlii</i>	Vahl's eelpout	Lycode à carreaux	647	<a href="#">127118</a>	565	LI
			<i>Melanostigma atlanticum</i>	Atlantic soft pout	Molasse atlantique	646	<a href="#">127120</a>	43	LR
			<i>Zoarces americanus</i>	Ocean pout	Loquette d'Amérique	640	<a href="#">159267</a>	1478	LF
<i>Pleuronectiformes</i>		Cynoglossidae	<i>Syphurus diomedeanus</i>	Spottedfin tonguefish	Langue fil noir	816	<a href="#">159358</a>	24	LR

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
		Paralichthyidae	<i>Citharichthys arctifrons</i>	Gulf Stream flounder	Plie du Gulf Stream	44	<a href="#">158791</a>	382	LI
			<i>Hippoglossina oblonga</i>	Fourspot flounder	Cardeau à quatre ocelles	142	<a href="#">158833</a>	76	LR
		Pleuronectidae	<i>Glyptocephalus cynoglossus</i>	Witch flounder	Plie grise	41	<a href="#">127136</a>	4301	LF
			<i>Hippoglossoides platessoides</i>	American plaice	Plie canadienne	40	<a href="#">127137</a>	6023	LF
			<i>Hippoglossus hippoglossus</i>	Atlantic halibut	Flétan de l'Atlantique	30	<a href="#">127138</a>	1634	LF
			<i>Limanda ferruginea</i>	Yellowtail flounder	Limande à queue jaune	42	<a href="#">158879</a>	3233	LF
			<i>Pseudopleuronectes americanus</i>	Winter flounder	Limande-plie rouge	43	<a href="#">158885</a>	1632	LF
			<i>Reinhardtius hippoglossoides</i>	Greenland halibut	Flétan noir	31	<a href="#">127144</a>	736	LI
		Scophthalmidae	<i>Scophthalmus aquosus</i>	Windowpane flounder	Turbot de sable	143	<a href="#">158907</a>	115	LR
Scorpaeniformes	Agonidae		<i>Agonidae</i>	Alligatorfishes	Poissons-alligator	351	<a href="#">125588</a>	43	LR
			<i>Aspidophoroides monopterygius</i>	Alligatorfish	Poisson-alligator atlantique	340	<a href="#">159459</a>	1029	LF
			<i>Leptagonus decagonus</i>	Atlantic poacher	Agone atlantique	350	<a href="#">127191</a>	266	LI
			<i>Ulcina olrikii</i>	Arctic alligatorfish	Poisson-alligator arctique	341	<a href="#">274356</a>	13	LR
	Cottidae		<i>Artediellus atlanticus</i>	Atlantic hookear sculpin	Hameçon atlantique	880	<a href="#">127193</a>	258	LI
			<i>Artediellus uncinatus</i>	Arctic hookear sculpin	Hameçon neigeux	306	<a href="#">127195</a>	306	LI

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Perciformes	Triglidae		<i>Icelus spatula</i>	Spatulate sculpin	lcèle spatulée	314	127200	40	LR
			<i>Myoxocephalus aenaeus</i>	Grubby	Chabosseau bronzé	303	159519	40	LR
			<i>Myoxocephalus octodecemspinosus</i>	Longhorn sculpin	Chabosseau à dix-huit épines	300	159520	3292	LF
			<i>Myoxocephalus scorpius</i>	Shorthorn sculpin	Chabosseau à épines courtes	301	127203	131	LR
			<i>Triglops murrayi</i>	Moustache sculpin	Faux-trigle armé	304	127205	1182	LF
	Cyclopteridae		<i>Cyclopterus lumpus</i>	Lumpfish	Lompe	501	127214	216	LI
			<i>Eumicrotremus spinosus</i>	Atlantic spiny lumpucker	Petite poule de mer atlantique	502	127217	226	LI
	Hemitripteridae		<i>Hemitripterus americanus</i>	Sea raven	Hémithriptère atlantique	320	159518	2126	LF
	Liparidae		<i>Careproctus reinhardtii</i>	Sea tadpole	Petite limace de mer	520	127212	18	LR
			<i>Liparis atlanticus</i>	Atlantic seasnail	Limace atlantique	503	159524	34	LR
			<i>Liparis fabricii</i>	Gelatinous snailfish	Limace gélatineuse	505	127218	27	LR
			<i>Liparis gibbus</i>	Variegated snailfish	Limace marbée	512	159526	41	LR
Stomiiformes	Psychrolutidae		<i>Cottunculus microps</i>	Polar sculpin	Cotte polaire	307	127235	29	LR
	Sebastidae		<i>Helicolenus dactylopterus</i>	Blackbelly rosefish	Sébaste chèvre	123	127251	610	LI
			<i>Sebastes</i>	Atlantic redfishes	Sébastes de l'Atlantique	23	126175	4152	LF
	Sternopychidae		<i>Maurolicus muelleri</i>	Silvery lightfish	Brossé améthyste	158	127312	52	LR
			<i>Sternopychidae</i>	Hatchetfishes	Haches d'argent	741	125603	21	LR
	Stomiidae		<i>Stomias boa</i>	Boa dragonfish	Dragon-boa	159	127374	20	LR
<i>Zeiformes</i>									

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
		Zeidae	<i>Zenopsis conchifer</i>	Silvery John dory	Saint Pierre argenté	704	<a href="#">127426</a>	39	LR
<b>Cephalopoda</b>									
<i>Myopsida</i>									
		Loliginidae	<i>Doryteuthis pealeii</i>	Longfin inshore squid	Calmar totam	4512	<a href="#">574541</a>	96	LR
<i>Oegopsida</i>									
		Ommastrephidae	<i>Illex illecebrosus</i>	Northern shortfin squid	Encornet rouge nordique	4511	<a href="#">153087</a>	4836	LF
<b>Elasmobranchii</b>									
<i>Rajiformes</i>									
		Rajidae	<i>Amblyraja radiata</i>	Thorny skate	Raie épineuse	201	<a href="#">105865</a>	3937	LF
			<i>Dipturus laevis</i>	Barndoor skate	Grande raie	200	<a href="#">158548</a>	246	LI
			<i>Leucoraja erinacea</i>	Little skate	Raie hérisson	203	<a href="#">158551</a>	712	LI
			<i>Leucoraja ocellata</i>	Winter skate	Raie tachetée	204	<a href="#">158553</a>	1180	LF
			<i>Malacoraja senta</i>	Smooth skate	Raie lisse	202	<a href="#">158554</a>	1773	LF
<i>Squaliformes</i>									
		Etmopteridae	<i>Centroscyllium fabricii</i>	Black dogfish	Aiguillat noir	221	<a href="#">105906</a>	31	LR
		Squalidae	<i>Squalus acanthias</i>	Piked dogfish	Aiguillat commun	220	<a href="#">105923</a>	1985	LF
<b>Malacostraca</b>									
<i>Decapoda</i>									
		Cancridae	<i>Cancer borealis</i>	Jonah crab	Tourteau jona	2511	<a href="#">158056</a>	1387	SF
			<i>Cancer irroratus</i>	Atlantic rock crab	Tourteau poïnclos	2513	<a href="#">158057</a>	788	SF
		Geryonidae	<i>Chaceon quinquedens</i>	Red deepsea crab	Crabe rouge	2532	<a href="#">158407</a>	33	SR
		Lithodidae	<i>Lithodes maja</i>	Atlantic king crab	Crabe épineux du nord	2523	<a href="#">107205</a>	531	SF
		Nephropidae	<i>Homarus americanus</i>	American lobster	Homard américain	2550	<a href="#">156134</a>	1623	SF

Class	Order	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Oregoniidae			<i>Chionoecetes opilio</i>	Queen crab	Crabe des neiges	2526	<a href="#">107315</a>	1546	SF
			<i>Hyas araneus</i>	Great spider crab	Crabe lyre araignée	2527	<a href="#">107322</a>	625	SF
			<i>Hyas coarctatus</i>	Arctic lyre crab	Crabe Hyas coarctatus	2521	<a href="#">107323</a>	711	SF
		Pandalidae	<i>Pandalus borealis</i>	Northern prawn	Crevette nordique	2211	<a href="#">107649</a>	718	SF
<b>Myxini</b>									
<i>Myxiniformes</i>									
		Myxinidae	<i>Myxine glutinosa</i>	Atlantic hagfish	Myxine du nord	241	<a href="#">101170</a>	804	LI
<b>Petromyzonti</b>									
<i>Petromyzontiformes</i>									
		Petromyzontidae	<i>Petromyzon marinus</i>	Sea lamprey	Lamproie marine	240	<a href="#">101174</a>	16	LR

298 **2.4 Analyses**

299 The Oracle relational database where all survey data are stored and archived is accessible from  
300 the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Queries written in Structured  
301 Query Language (SQL) are used to extract the data from the production server and to create the  
302 data products used in all subsequent analyses. Catch records classified as "valid" (i.e. coming  
303 from a representative tow without damage to the net) are used in the current analyses. To make  
304 the available samples comparable, catch number and weight for each species was standardized  
305 for the distance towed.

306 All data processing and analyses were conducted using the R software (R Core Team 2020)  
307 using packages gstat (Pebesma 2004), PBSmapping (Schnute et al. 2019), RODBC (Ripley  
308 and Lapsley 2019), spatstat (Baddeley 2015), maptools (Bivand and Lewin-Koh 2020), rgeos  
309 (Bivand and Rundel 2020), classInt(Bivand 2020), RColorBrewer(Neuwirth 2014), MASS (Ripley  
310 et al. 2020), worms (Holstein 2018), and tidyverse (Wickham 2019). The present document is  
311 rendered as a Technical Report using the csasdown R package developed and maintained by  
312 Fisheries and Oceans Canada scientists (Anderson et al. In press).

313 **2.4.1 Geographic distribution of catches**

314 Spatial interpolation of catch biomass (kg/tow) or abundance (number/tow) was done using a  
315 weighting inversely proportional to the distance (inverse-distance weighted, IDW), using function  
316 "idw" of the spatstat R package (Baddeley 2015). The IDW method was used with a power  
317 parameter value of 10.

318 **2.4.2 Abundance and biomass indices**

319 For each species, stratified random estimates of catch abundance and biomass (Smith 1996)  
320 were computed for each year. Yearly estimates of the standard error were also computed.

321 **2.4.3 Distribution indices**

322 For each Category L, I and S fish species, the minimum area required to account for 75% and  
323 95% of the total biomass or abundance were computed (D75% and D95%). These measures of  
324 distributions were computed for each year by using the Lorenz curve of mean stratum-level catch  
325 estimates and the area of occupied strata (Swain and Sinclair 1994; Swain and Morin 1996).

326 **2.4.4 Length frequencies**

327 The length frequency distribution of catch (the stratified numbers-at-length) is tabulated for each  
328 seven-year period (1970-2009), and last ten-year period (2010-2020).

329 **2.4.5 Length-weight relationship and condition factor**

330 The relationship between the weight and the length of fish was estimated using the following  
331 non-linear isometric relationship:

$$W = \alpha L^\beta$$

332 where W is the total weight (g), L is the length (cm), and,  $\alpha$  and  $\beta$  are the parameters to be  
333 estimated.

334 Average fish condition (C) was computed as:

$$C = \frac{W}{\alpha L^\beta}$$

335

336 **2.4.6 Depth, temperature and salinity distribution of catches**

337 For each category L species, We followed the methods developed by (Perry and Smith 1994)  
338 and generated cumulative frequency distributions of depth, temperature and salinity of survey  
339 catches.

340 **2.4.7 Density-dependent habitat selection**

341 We followed the methods of (Myers and Stokes 1989) to evaluate how fish abundance in each  
342 stratum varied with overall temporal fluctuations of population abundance.

343 For each category L species, we fitted a model of the relationship between stratum-level density  
344 and overall abundance (the yearly stratified random estimate of abundance, defined above).  
345 To properly use the observations of zero catch while accounting for the logarithmic distribution  
346 of catch abundance, we implemented the model as a generalised linear using a log link and a  
347 Poisson error distribution:

$$Y_{h,i} = \alpha_{h,i} Y_i^{\beta_{h,i}}$$

348 where,  $y_{h,i}$  is the average abundance of stratum  $h$  in year  $i$ , and  $\alpha_{h,i}$  and  $\beta_{h,i}$  are the fitted  
349 parameters. The estimated parameter  $\beta_{h,i}$  is referred to as the “slope parameter” and indicates  
350 whether stratum-level density is positively ( $\beta_{h,i} <= 0$ ), negatively ( $\beta_{h,i} >= 0$ ) or negligibly  
351 ( $\beta_{h,i} \approx 0$ ) related to population abundance.

352 To estimate the suitability of each stratum, the median abundance observed during the years  
353 that are in the top 25% of yearly estimates is used. We combine the slope parameter estimates  
354 from the above model with the median abundance to identify strata that have consistently high  
355 abundance and whose local density is weakly related to fluctuation in population abundance  
356 ( $\beta_{h,i} \approx 0$ ). Preferred strata are identified for each category L species.

357

### 3 Results

358 The depth, bottom temperature and bottom salinity cumulative frequency distribution for the  
359 survey are presented in Figure 4.



Figure 4. Cumulative frequency distribution of depth, bottom temperature and bottom salinity of representative sets from the summer survey.

360 The plots generated for each species are presented in the Appendix.

#### 361 3.1 Description of Figures

##### 362 3.1.1 Type A

363 For Category L and S species:

364 Spatial distribution of catch-per unit of effort, (CPUE, kilograms per tow) in July-August for the  
365 Bay of Fundy and Scotian Shelf in five-year periods. Spatial interpolation between tows was  
366 done using Inverse Distance Weight (IDW). The probability of occurrence (proportion of tows with  
367 catch records for a given species) was also reported for each five-year period.

368 For Category LR and SR:

369 Location of tows with catch over the period 1970-2020 (Type LR) or the period 1999-2020 (Type  
370 SR). Location of tows with catch over the period 1970-2020 (Type LR) or the period 1999-2020  
371 (Type SR).

372 **3.1.2 Type B**

373 For Category L, S and I species:

374 Stratified random estimate of CPUE (left panel), distribution indices (D75% and D95%, the  
375 minimum area containing 75% and 95% of biomass, middle panel), and distribution vs. weight  
376 per tow (right panel). The stratified random mean is plotted as a solid line with the 95%  
377 confidence region indicated by the solid grey line. The overall mean is plotted as a grey  
378 horizontal line and the overall mean plus or minus 50% of the standard deviation appear as  
379 horizontal dashed lines. In all three panels, the early years appear in blue and the last years  
380 appear in red. The predictions from a loess estimator are overlaid on the distribution indices  
381 (middle panel). The Pearson correlation coefficient between D75% and biomass, and its  
382 statistical significance, are also reported in the right panel.

383 **3.1.3 Type C.**

384 Length frequency distribution for NAFO divisions 4X and 4VW. A smoothed length frequency  
385 distribution is shown for each 7-year periods covered by the surveys.

386 **3.1.4 Type D.**

387 Average fish condition for all fish lengths (black dots and black line), large fish (thick gray line),  
388 and small fish (thin gray line). Fish condition is presented for NAFO divisions 4VW (right panel)  
389 and 4X (left panel).

390 **3.1.5 Type E.**

391 Cumulative frequency distributions of depth, temperature and salinity at all sampled locations  
392 (thick solid line) and at fishing locations with catch records (thin dashed line). The depth,  
393 temperature and salinity associated with 5%, 25%, 50%, 75% and 95% of the cumulative catch is  
394 shown in tabular fashion on the bottom right panel.

395 **3.1.6 Type F.**

396 Slopes estimates from the density-dependent habitat selection model (y axis) plotted versus  
397 the median abundance during the top 25% of years. The red box indicates strata of particular  
398 importance for a species by identifying slopes that are within a standard error from zero and that  
399 are within the top 25% of median abundance. Each stratum is identified on the plot by the last  
400 two digits of its number.

401 **3.2 Summary of successful tows by year and stratum**

402 A total of 9080 representative tows were conducted for the period spanning from 1970 to 2020  
403 (Figure 5).

404 Tables 4, 5 and 6 present the number of tows conducted in each stratum and year.

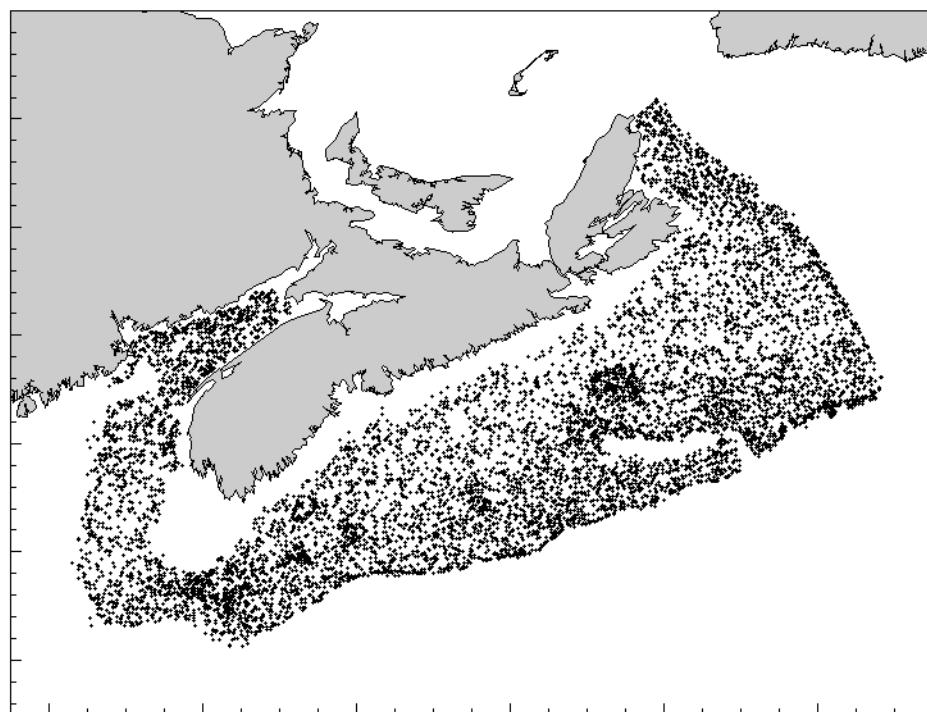


Figure 5. Map of the Summer survey tows.

Table 4. Number of representative tows conducted in each stratum during the period 1970 to 1989.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
440	4VN	3173.016	4	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	5	5	6	4
441	4VN	3434.000	4	2	2	3	3	3	1	3	3	3	3	3	3	3	3	5	5	4	4	4
442	4VN	4934.658	3	2	2	2	3	3	2	3	3	3	3	3	3	3	3	3	5	6	7	5
443	4VSW	4526.012	4	2	4	4	8	3	1	2	4	4	4	3	3	5	4	4	6	6	5	2
444	4VSW	13478.450	3	2	5	4	6	4	6	7	4	4	4	5	5	6	4	4	6	6	3	6
445	4VSW	3512.982	5	2	5	4	5	5	1	3	4	4	4	5	5	3	4	5	6	4	4	4
446	4VSW	1686.094	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3
447	4VSW	5549.344	4	2	6	5	7	4	4	3	4	4	4	5	4	4	4	4	5	7	6	6
448	4VSW	4975.866	5	2	5	4	5	4	4	4	4	4	4	4	6	4	4	4	5	5	5	5
449	4VSW	494.496	2	2	2	2	3	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2
450	4VSW	1315.222	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
451	4VSW	504.798	1	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2
452	4VSW	1184.730	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2
453	4VSW	889.406	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
454	4VSW	1713.566	3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	2
455	4VSW	7286.948	7	6	7	6	7	6	6	7	7	7	7	7	7	7	7	8	7	7	7	7
456	4VSW	3279.470	5	4	6	5	5	6	4	6	6	6	7	6	6	6	6	6	7	6	6	6
457	4VSW	2784.974	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	4	2	2
458	4VSW	2259.572	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3
459	4VSW	10810.232	3	2	4	4	4	4	4	4	4	4	4	4	3	4	4	6	6	5	6	5
460	4VSW	4615.296	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	4	3	3	3
461	4VSW	3962.836	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2
462	4VSW	7266.344	3	3	4	3	4	4	4	4	4	4	4	6	4	4	4	4	6	5	4	4
463	4VSW	1037.068	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
464	4VSW	4453.898	4	3	5	3	3	6	5	5	5	5	5	4	5	5	5	7	6	5	5	5
465	4VSW	8183.222	6	5	5	4	5	4	5	5	5	5	5	7	6	5	5	5	8	8	8	8
466	4VSW	776.084	2	2	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	2
470	4X	3159.280	1	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3
471	4X	3447.736	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
472	4X	4289.066	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
476	4X	5075.452	2	2	2	2	2	2	3	2	2	2	1	2	2	2	2	2	2	4	4	4
477	4X	4230.688	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	5	4	4
478	4X	800.122	2	2	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	2	2	2
480	4X	2249.270	4	4	4	3	3	3	4	4	3	4	3	3	4	4	4	4	4	4	4	4
481	4X	6438.750	5	3	4	4	4	3	4	4	5	4	3	4	4	4	4	4	4	6	7	6
482	4X	3578.228	2	1	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	3	3	3
483	4X	1826.888	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2
484	4X	7774.576	2	2	3	3	3	3	3	3	2	3	3	3	4	3	3	3	4	4	4	4
485	4X	5432.588	2	2	2	3	3	3	3	3	3	2	3	4	3	3	3	3	6	7	6	6
490	4X	2063.834	2	2	2	2	2	3	3	3	3	2	3	3	3	3	3	3	3	4	4	4
491	4X	2359.158	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
492	4X	3729.324	3	2	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
493	4X	1830.322	1	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
495	4X	2005.456	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2
		171809.888	134	110	146	134	153	143	135	144	141	147	145	150	150	146	143	152	171	188	177	170

Table 5. Number of representative tows conducted in each stratum during the period 1990 to 2009.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
440	4VN	3173.016	4	4	4	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4	3	4	
441	4VN	3434.000	6	5	5	5	5	5	5	5	6	7	6	6	7	6	7	6	6	5	6		
442	4VN	4934.658	5	5	6	5	6	6	6	6	7	6	6	5	6	6	7	5	5	5	6		
443	4VSW	4526.012	4	2	4	3	3	4	4	5	5	4	4	5	5	5	5	4	4	4	5	4	
444	4VSW	13478.450	7	8	8	9	6	8	8	7	8	8	9	10	9	9	9	8	10	8	6	9	
445	4VSW	3512.982	4	4	4	5	7	4	4	4	3	3	6	5	5	5	5	6	5	4	3	6	
446	4VSW	1686.094	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	
447	4VSW	5549.344	8	7	7	7	7	7	6	7	7	6	7	7	7	7	7	7	6	6	4	6	
448	4VSW	4975.866	9	6	6	7	7	7	6	7	6	7	8	8	8	8	7	8	8	6	5	7	
449	4VSW	494.496	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	
450	4VSW	1315.222	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	
451	4VSW	504.798	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	2	2	
452	4VSW	1184.730	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
453	4VSW	889.406	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	
454	4VSW	1713.566	3	2	2	2	2	2	3	2	2	2	2	2	2	2	2	3	2	2	2	2	
455	4VSW	7286.948	12	10	10	9	10	10	10	13	8	11	11	11	11	11	8	12	11	7	5	8	
456	4VSW	3279.470	10	7	7	8	8	8	8	8	6	8	10	8	8	8	8	8	8	6	2	7	
457	4VSW	2784.974	4	2	2	2	2	2	2	2	1	4	2	2	2	2	2	2	2	2	2	2	
458	4VSW	2259.572	9	8	8	8	8	8	7	8	5	6	10	8	7	8	8	10	8	5	2	7	
459	4VSW	10810.232	5	5	6	4	6	6	4	5	6	6	8	6	6	6	6	6	6	5	3	6	
460	4VSW	4615.296	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	2	3	3	
461	4VSW	3962.836	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	
462	4VSW	7266.344	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	3	4	4	
463	4VSW	1037.068	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	
464	4VSW	4453.898	9	7	7	7	7	7	7	4	7	7	7	7	7	7	5	8	7	6	4	5	
465	4VSW	8183.222	12	9	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	7	8	7	
466	4VSW	776.084	3	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	2	1	3	2	
470	4X	3159.280	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
471	4X	3447.736	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	
472	4X	4289.066	6	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	3	4	3	
473	4X	910.010	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
476	4X	5075.452	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	
477	4X	4230.688	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
478	4X	800.122	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2	
480	4X	2249.270	8	8	8	8	8	8	8	8	8	8	7	8	8	8	7	9	8	8	8	8	
481	4X	6438.750	8	9	9	9	9	7	9	9	9	9	8	9	8	9	8	9	6	12	9	7	8
482	4X	3578.228	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	4	3	3	3	
483	4X	1826.888	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
484	4X	7774.576	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	4	4	3	4	
485	4X	5432.588	2	3	3	3	3	3	3	3	3	3	3	4	3	5	5	3	2	5	4	5	
490	4X	2063.834	4	4	4	4	4	5	4	4	4	3	4	4	4	4	4	4	3	3	3	4	
491	4X	2359.158	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	4	
492	4X	3729.324	3	3	3	3	3	2	3	3	3	3	3	3	3	3	5	2	3	4	4	4	
493	4X	1830.322	3	3	3	3	3	2	3	3	2	3	3	3	4	5	2	4	4	3	3	4	
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	3	3	4	
495	4X	2005.456	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5	3	3	4	
		171809.888	213	189	193	190	195	195	191	193	186	191	213	201	208	216	188	222	209	177	165	196	

Table 6. Number of representative tows conducted in each stratum during the period 2010 to 2020 and for the whole 1970 to 2020 period.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
440	4VN	3173.016	4	5	4	4	4	4	4	4	0	5	4	190
441	4VN	3434.000	6	7	6	6	6	6	6	6	0	7	4	238
442	4VN	4934.658	5	6	6	6	6	6	6	6	0	6	5	240
443	4VSW	4526.012	4	6	5	5	3	7	4	5	0	9	4	214
444	4VSW	13478.450	11	13	9	8	9	9	11	10	0	6	8	352
445	4VSW	3512.982	4	7	2	4	3	4	4	4	0	6	3	215
446	4VSW	1686.094	3	4	3	3	3	2	3	2	0	3	2	145
447	4VSW	5549.344	6	8	6	7	7	7	7	7	0	6	5	291
448	4VSW	4975.866	7	10	8	8	8	7	6	6	0	7	4	299
449	4VSW	494.496	2	4	2	2	2	2	2	2	0	2	2	100
450	4VSW	1315.222	3	3	3	3	3	3	3	2	0	3	2	144
451	4VSW	504.798	2	2	2	2	2	2	2	2	0	2	2	104
452	4VSW	1184.730	2	2	2	2	1	4	3	3	0	3	3	110
453	4VSW	889.406	2	1	3	2	3	2	2	1	0	2	2	116
454	4VSW	1713.566	2	4	2	2	2	2	2	2	0	3	2	121
455	4VSW	7286.948	10	10	10	11	11	9	9	8	0	9	6	429
456	4VSW	3279.470	7	9	8	8	6	5	6	6	0	6	4	331
457	4VSW	2784.974	2	4	2	2	2	3	3	3	0	3	2	113
458	4VSW	2259.572	6	9	8	6	4	5	5	5	0	6	3	269
459	4VSW	10810.232	6	7	6	6	6	7	7	6	0	9	7	262
460	4VSW	4615.296	3	4	4	3	3	5	5	5	3	6	5	151
461	4VSW	3962.836	2	3	3	2	2	3	3	3	2	3	3	113
462	4VSW	7266.344	4	6	4	4	5	5	5	5	0	5	5	212
463	4VSW	1037.068	2	3	2	2	2	3	2	2	0	2	2	107
464	4VSW	4453.898	6	7	7	7	7	6	6	4	0	6	4	288
465	4VSW	8183.222	8	10	10	10	10	9	7	3	10	7	397	
466	4VSW	776.084	2	2	2	2	2	2	2	3	0	3	2	118
470	4X	3159.280	2	2	3	2	2	3	3	3	4	3	2	112
471	4X	3447.736	2	2	3	2	2	3	3	3	4	4	3	110
472	4X	4289.066	4	6	4	4	4	4	4	4	4	4	4	172
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	104
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	100
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	103
476	4X	5075.452	4	4	4	4	4	5	5	5	5	5	5	177
477	4X	4230.688	5	4	5	5	6	5	5	4	4	6	4	204
478	4X	800.122	2	2	2	2	2	2	2	3	2	2	2	119
480	4X	2249.270	8	7	8	8	6	7	7	5	7	5	7	306
481	4X	6438.750	8	10	9	9	9	8	10	9	6	9	6	350
482	4X	3578.228	3	4	3	3	3	3	4	4	3	4	3	141
483	4X	1826.888	2	3	2	2	2	2	3	3	2	3	2	105
484	4X	7774.576	3	5	5	5	4	6	5	7	7	7	7	186
485	4X	5432.588	5	6	5	5	5	6	6	6	4	6	5	196
490	4X	2063.834	3	4	2	4	3	4	4	4	3	4	3	173
491	4X	2359.158	4	4	4	4	4	4	4	4	3	4	3	168
492	4X	3729.324	4	6	4	4	4	3	4	4	3	4	4	171
493	4X	1830.322	3	4	4	4	3	3	4	6	3	3	3	159
494	4X	1431.978	4	4	4	4	3	4	4	3	2	4	3	128
495	4X	2005.456	3	4	4	4	2	4	4	4	3	4	3	127
		171809.888	196	243	210	208	196	212	214	208	81	227	175	9080

## 4 Discussion

406 This report builds on previous work and former atlases by updating a comprehensive suite of  
407 indices to give a snapshot of population status and environmental preferences of 104 fish and  
408 invertebrate species. The current document is not meant to replace stock assessments, species-  
409 specific analyses of abundance, biomass and distribution, or any targeted attempts to integrate  
410 information about species or group of species from the wide and disparate sources of data about  
411 marine organisms in the area covered by the DFO Maritimes summer trawl survey. It is rather  
412 meant to provide a reproducible set of tools to extract and visualize the information collected  
413 in the summer groundfish research vessel survey. It is hoped that this document can provide a  
414 stepping stone to conduct other ecological analyses using the trawl survey data and increase  
415 reproducibility and transparency of ecological information collected annually.

416 **4.1 Diversity of approaches used for mapping fish and invertebrates in the Scotian Shelf  
417 bioregion**

418 Different methods have been applied in the Northwest Atlantic, and specifically on the Scotian  
419 Shelf bioregion, to map fish and invertebrate species distribution. The present report, for  
420 example, builds upon the atlas of important habitat developed to map the persistence of relatively  
421 high biomass for key fish species using the summer groundfish research vessel survey (Horsman  
422 and Shackell 2009). Important habitat was obtained by interpolating observed weight per each  
423 species using an inverse-distance weighted (IDW) methodology, and calculating areas with  
424 relatively persistent high biomass for periods representing different fishery management eras.  
425 To compliment information from this atlas, including additional representations of biomass and  
426 diversity, a similar IDW interpolation mapping procedure was followed by Smith et al. (2015),  
427 Ward-Paige and Bundy (2015), and Bundy et al. (2017). The summer groundfish research vessel  
428 survey is typically conducted during the month of July. However, from the fall of 1978 through to  
429 the spring of 1985, DFO also conducted spring and fall surveys using the same sampling design.  
430 This unique seasonal data was used to map the seasonal spatial distribution of key demersal  
431 and other fish species using IDW interpolation on the Scotian Shelf from the spring, summer  
432 and fall between 1978 and 1985 (Smith et al. 2015). Following recommendations provided by  
433 Kenchington and Kenchington (2017), the spatial distribution of three indicators of biodiversity  
434 for fish and invertebrates were mapped using IDW interpolation to identify areas with persistently  
435 high values across fishery management eras, and compared with areas of persistently high  
436 abundance for selected species (Ward-Paige and Bundy 2015). This analysis revealed a lack of  
437 consistent relationships between areas of persistent high diversity and persistent high biomass,  
438 suggesting that both can be used as independent and important spatial indicators of the system  
439 (Ward-Paige and Bundy 2015). Groupings of fishes and invertebrates based on size, habitat  
440 and feeding guild, were also mapped using IDW interpolations to identify hotspots of functional  
441 group diversity (Bundy et al. 2017). This analysis revealed a spatially and temporally variable  
442 distribution of functional diversity across the Scotian Shelf with notable areas of high and low  
443 diversity (Bundy et al. 2017). Top quintiles of each functional group using the IDW approach  
444 were used as representative layers for fish and invertebrates in the MPA Network design in the  
445 Scotian Shelf Bioregion (Serdynska et al. In press). IDW interpolation methods have also been  
446 used to map the distribution of individual species such as sea cucumbers (*Cucumaria frondosa*)

447 in the Scotian Shelf bioregion (Shackell et al. 2013), and sea scallop (*Placopecten magellanicus*)  
448 in Georges and Browns Bank (Hubley et al. 2014).

449 Species Distribution Modelling (SDM), instead of IDW, can also be used to evaluate spatio-  
450 temporal dynamics by predicting and understanding past, present and future distribution  
451 of species using environmental predictors (Robinson et al. 2017). A variety of modelling  
452 approaches are being implemented in Maritimes Region to map and predict fish and invertebrate  
453 species distribution by incorporating environmental predictors to account for seasonal and  
454 temporal variability. For example, a stock assessment of snow crab (*Chionoecetes opilio*) on  
455 the Scotian Shelf used data from the snow crab survey from 2005 to 2018 to map spatial data  
456 products for this stock, including annual predicted interpolations of potential habitat using  
457 Generalized Additive Models (GAM) and several environmental covariates including depth,  
458 curvature, slope, species composition, and annual temperature (Zisserson et al. 2019). Sea  
459 scallop predicted habitat using Maximum Entropy (MaxEnt) models were computed for German  
460 Bank using data compiled via benthic habitat mapping and seafloor geotechnical surveys in  
461 2006, 2009, and 2010 (Brown et al. 2012). Predictions in the Scotian Shelf bioregion and the  
462 Northeast United States using datasets from DFO and the National Oceanic and Atmospheric  
463 Administration from 1993 to 2012 also predicted sea scallop habitat at a wider scale based  
464 on three scenarios of seasonal temperature and salinity climatologies (NOAA) (Lowen et  
465 al. 2019). Offshore American lobster stock assessments (*Homarus americanus*) used data  
466 from the RV, DFO Georges Bank, and National Marine Fisheries Service (NMFS) Northeast  
467 Fisheries Science Center (NEFSC) bottom trawl surveys (1970 to 2015) to predict species  
468 distribution using boosted regression trees and several environmental predictors (bathymetry,  
469 slope, curvature, and annual temperature interpolations) (Cook et al. 2017). Information on  
470 the potential for recovery of cusk (*Brosme brosme*) used data from the bottom longline Halibut  
471 industry survey and Cusk absences in the Summer groundfish research vessel survey from  
472 1998-2013 to predict suitable habitat using GAM, MaxEnt, and random forest models and  
473 several physical environmental variables (e.g. complexity, benthic current stress and complexity,  
474 temperature, salinity, primary production, chlorophyll, suspended matter) (Harris et al. 2018).  
475 Atlantic halibut (*Hippoglossus hippoglossus*) assessments using Summer groundfish research  
476 vessel survey and NOAA survey data from 2001 to 2013 predicted juvenile habitat using MaxEnt  
477 model and environmental predictors (bathymetry, slope, bottom temperature) (French et al.  
478 2018). Persistent areas of high Atlantic halibut juvenile abundance were predicted using data  
479 from 27 bottom trawl surveys combined (NMFS and DFO) from 1978 to 2013 and applying  
480 Bayesian hierarchical spatiotemporal models with two environmental predictors (depth and  
481 temperature) (Boudreau et al. 2017).

482 These examples of mapping efforts in Maritimes Region showcase the diversity of approaches  
483 relevant to a variety of important research questions and management applications. Approaches,  
484 methods, datasets, and environmental predictors are selected based on individual project  
485 research questions, and considerations for each species, communities or stock. This allows  
486 research groups to maintain innovation and keep up with emerging methods and technologies to  
487 improve assessments, predictions, and ultimately, science advice. The diversity of approaches  
488 also leads to complexity when looking across studies as each data compilation and predictive  
489 method carries its own independent assumptions and can lead to different spatial outputs.

490 **4.2 Interpreting spatial results for marine spatial planning purposes**

491 Fisheries and Oceans Canada is leading a marine spatial planning process that brings together  
492 relevant authorities and stakeholders to better coordinate how we use and manage marine  
493 spaces to achieve ecological, economic and social objectives. Operationalizing marine spatial  
494 planning includes a series of steps, including the process of analyzing existing conditions  
495 by collecting and mapping information about ecological, environmental and oceanographic  
496 conditions (Ehler and Douvere 2009; Agardy et al. 2011). Mapping the distribution of species  
497 is critical for the implementation of spatial management and as a first step in marine spatial  
498 planning processes. Species distribution have supported the identification of important sites for  
499 a given species or areas of high richness and diversity, which in turn can be used to inform siting  
500 decisions of new activities such as Marine Protected Areas (MPA), aquaculture sites or wind  
501 turbines. In the Scotian Shelf bioregion, mapping species distributions has been used to highlight  
502 areas of high biological diversity to support the identification of Ecologically or Biologically  
503 Significant Areas (Ricard and Shackell 2013; Ward-Paige and Bundy 2015), to distinguish  
504 important and persistent habitat of significant species and functional groups to support MPA and  
505 conservation planning (Horsman and Shackell 2009; Smith et al. 2015; Ward-Paige and Bundy  
506 2015; Bundy et al. 2017), to identify important habitat for Species at Risk (Harris et al. 2018) and  
507 to highlight reserves for data-poor invertebrate fisheries (Shackell et al. 2013). Mapping species  
508 distribution has also been used to illustrate multi-decadal scale projections of changes in species  
509 distribution in the context of climate change and adaption (Stanley et al. 2018; Greenan et al.  
510 2019).

511 In support of the marine spatial planning process, a public web-based atlas with relevant  
512 geospatial information is being developed to support decision-making. This Atlantic Canada-  
513 wide compilation of data and information will be a web-based, public platform with interactive  
514 maps of ocean ecosystems, human uses and management areas. This atlas cannot host the  
515 vast diversity of products and mapping approaches available in Maritimes Region. Consequently,  
516 we recommend that data products presented in this report should not be used for the atlas until  
517 an evaluation of the spatial information available and used in the past, is conducted.

518 This diverse portfolio of approaches and applications is not unique to the Maritimes Region. A  
519 recent review of global distribution modelling efforts recommended the adoption of a consistent  
520 framework that integrates multi-model approaches and a clear expression of errors and  
521 uncertainties (Robinson et al. 2017). In this context, Pacific Region has developed two initiatives  
522 to enable consistency and frequent publication, reproducibility, and transparency. One initiative  
523 developed a reproducible report to give a synthesis of data availability, population trends, fishing  
524 trends, growth and maturity patterns for 113 groundfish species in British Columbia to support  
525 stock assessment (Anderson et al. 2019). The second initiative developed a SDM framework  
526 that was applied to twelve species on Canada's Pacific coast as part of the Regional Response  
527 Plan (Nephin et al. 2019). The Maritimes and Gulf region, through this and past reports, are also  
528 using similar reproducible approaches to facilitate annual updates and transparency (Ricard and  
529 Shackell 2013; Ricard et al. 2021).

530 Recognizing the diversity of approaches for mapping fish and invertebrates in the Scotian Shelf  
531 bioregion, we recommend the development of a regional community of practice to compare  
532 and evaluate approaches for mapping, interpolating and/or modelling fish and invertebrates  
533 so future publications and advice related to spatial outputs can lead to more comparable work

534 and consistent science advice to support processes such as marine spatial planning. At the  
535 international level, guidelines and standards related to appropriate variables and methods  
536 for mapping and modeling species and communities of deep-sea habitats were proposed to  
537 encourage the production of publications that will lead to more comparable work (Kenchington  
538 et al. 2019). Similar general guidance for how groups approach mapping activities would be a  
539 worthwhile product in Maritimes Region. Until then, we propose the use of the Open Data record  
540 for the Maritimes RV surveys (DFO 2021) as a precursor to the public web-based atlas.

541

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## 7 Appendix

699

## 7.1 Atlantic cod (*Morue franche*) - species code 10 (category LF)

700

Scientific name: [Gadus morhua](#)

701

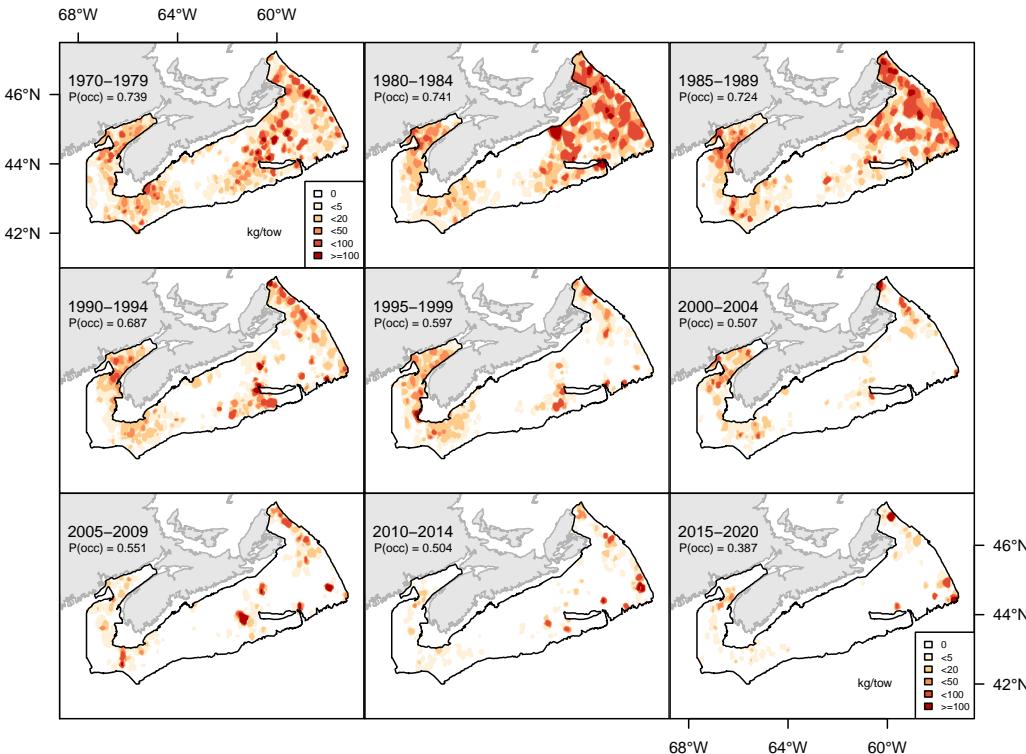


Figure 7.1A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic cod.

702

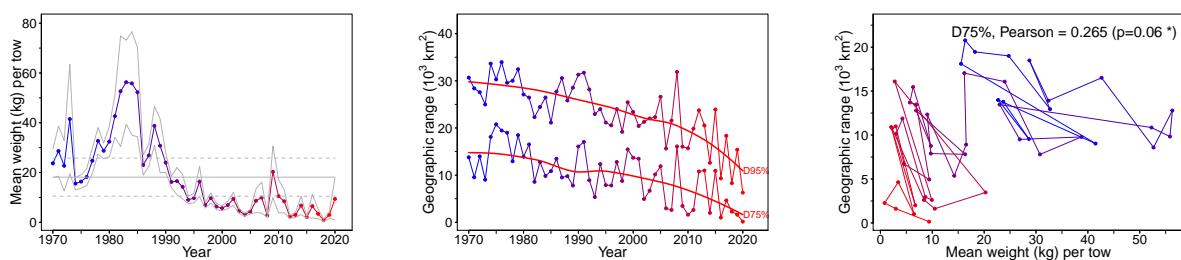


Figure 7.1B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic cod.

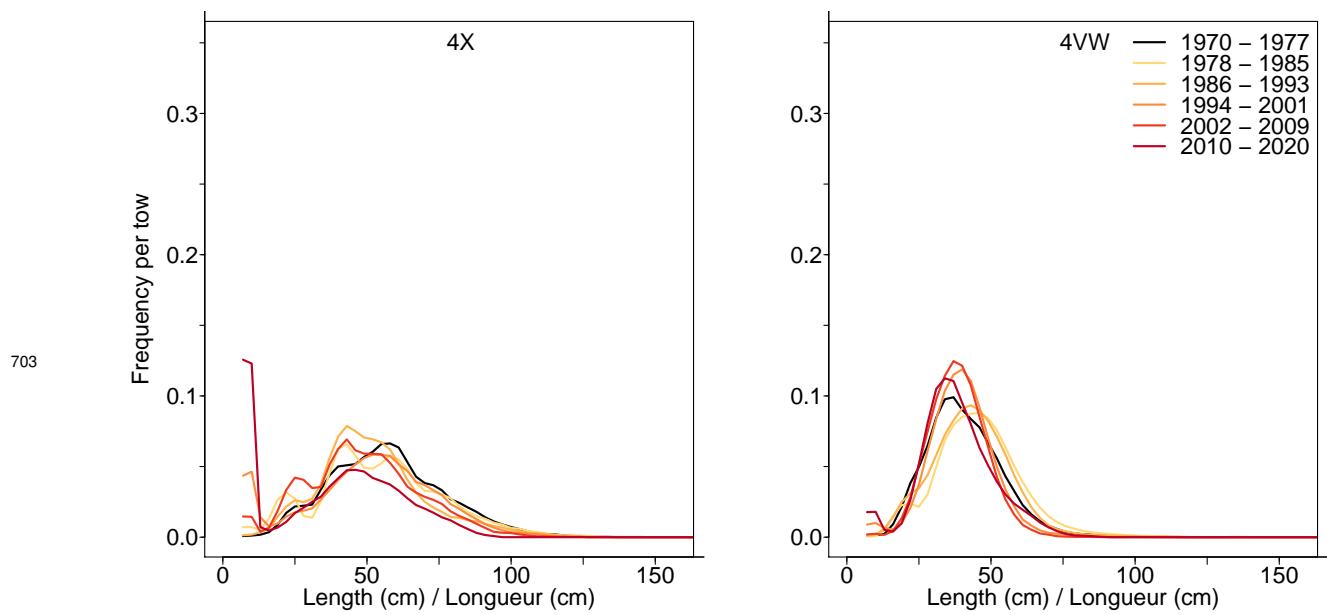


Figure 7.1C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic cod.

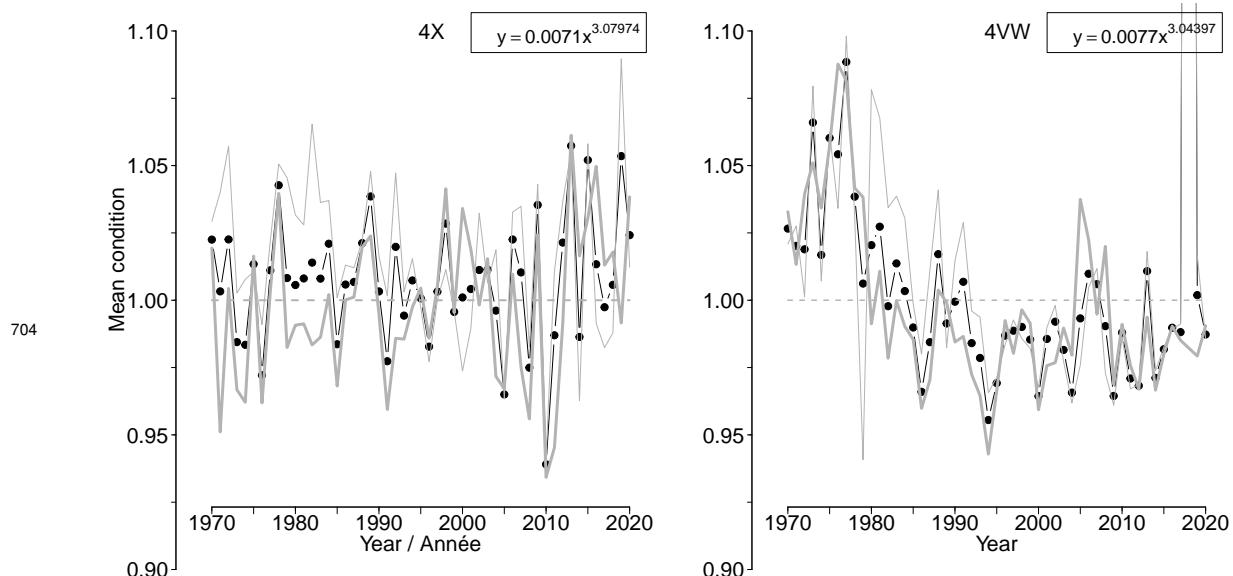
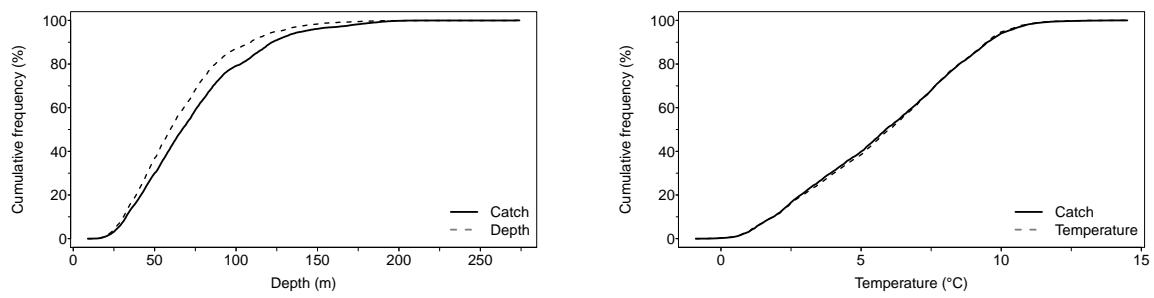
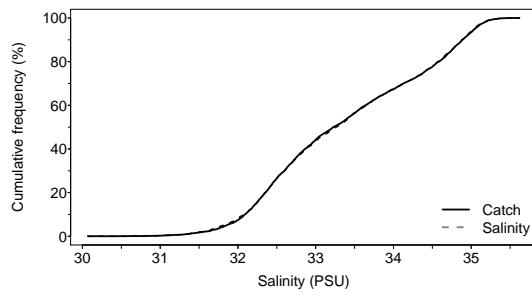


Figure 7.1D. Average fish condition in NAFO units 4X and 4VW for Atlantic cod.



705



Freq	Depth	Temp	Sal
F5	26	1.2	31.00
F25	43	3.5	32.47
F50	60	6.0	33.27
F75	82	8.1	34.40
F95	126	10.0	35.03

Figure 7.1E. Catch distribution by depth, temperature and salinity of Atlantic cod.

706

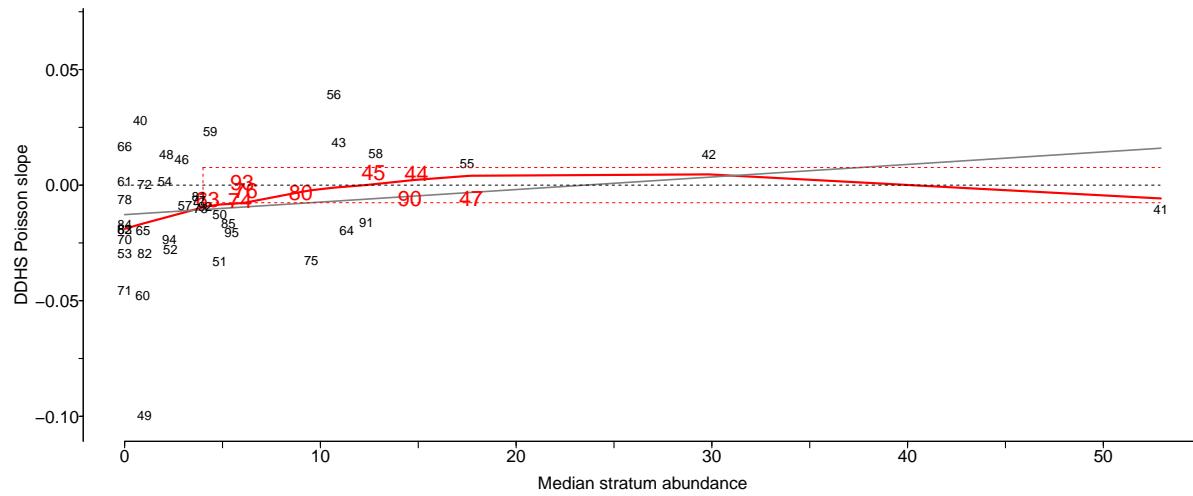


Figure 7.1F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic cod.

707

## 7.2 Haddock (Aiglefin) - species code 11 (category LF)

708

Scientific name: [Melanogrammus aeglefinus](#)

709

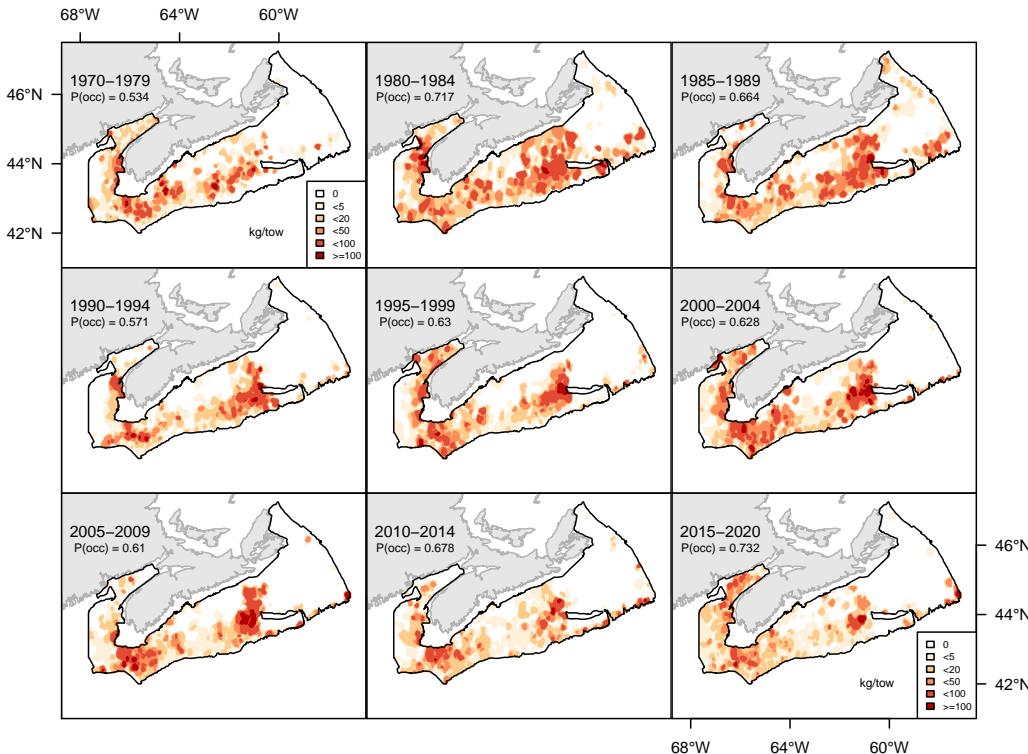


Figure 7.2A. Inverse distance weighted distribution of catch biomass (kg/tow) for Haddock.

710

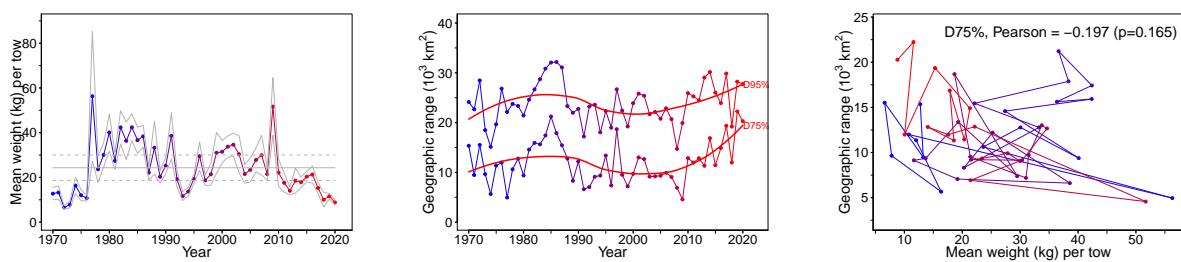


Figure 7.2B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Haddock.

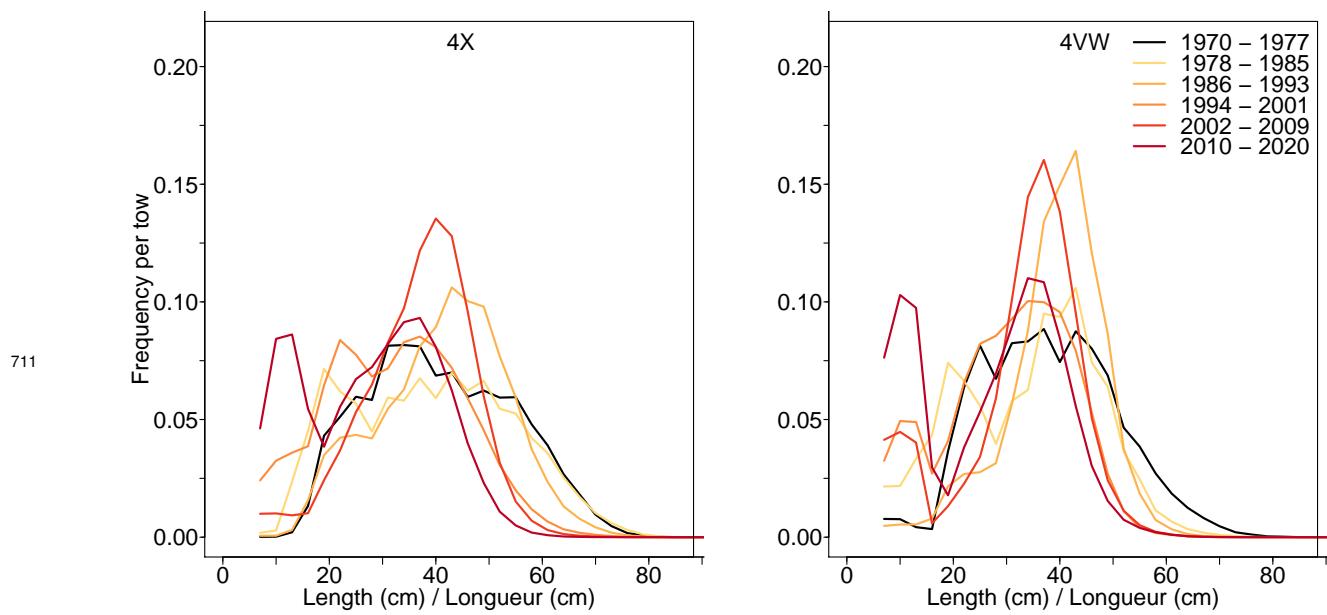


Figure 7.2C. Length frequency distribution in NAFO units 4X and 4VW for Haddock.

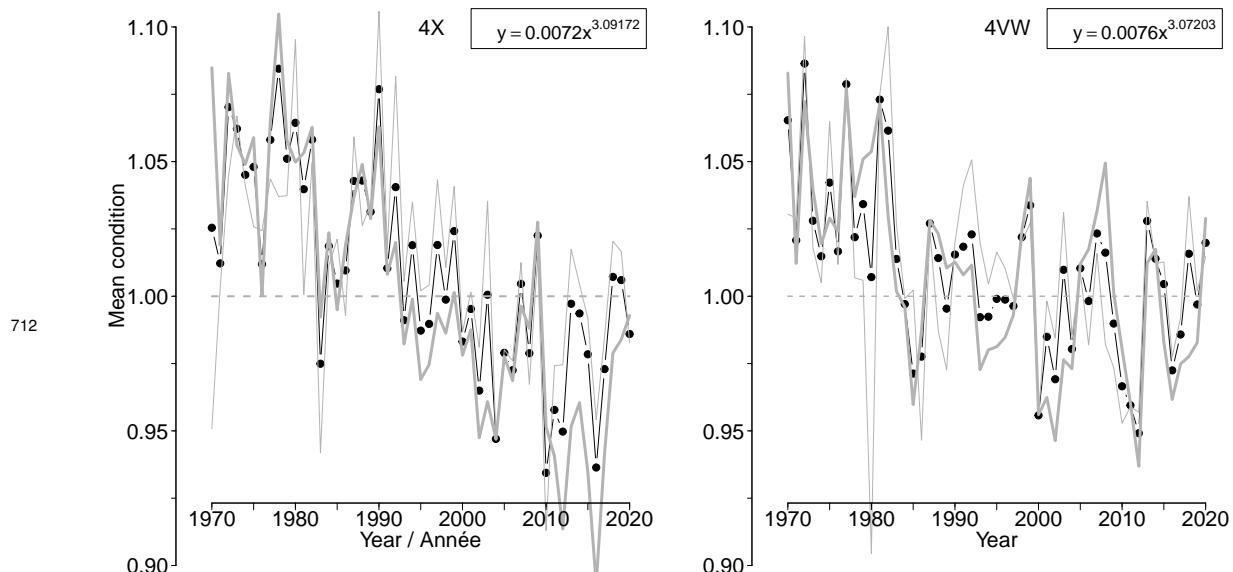
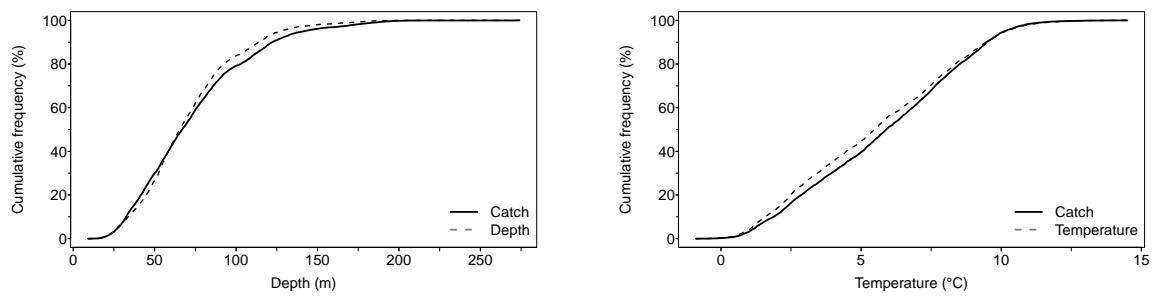
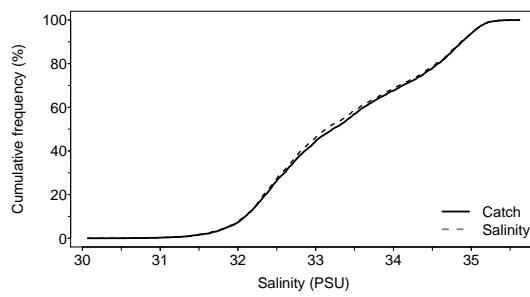


Figure 7.2D. Average fish condition in NAFO units 4X and 4VW for Haddock.

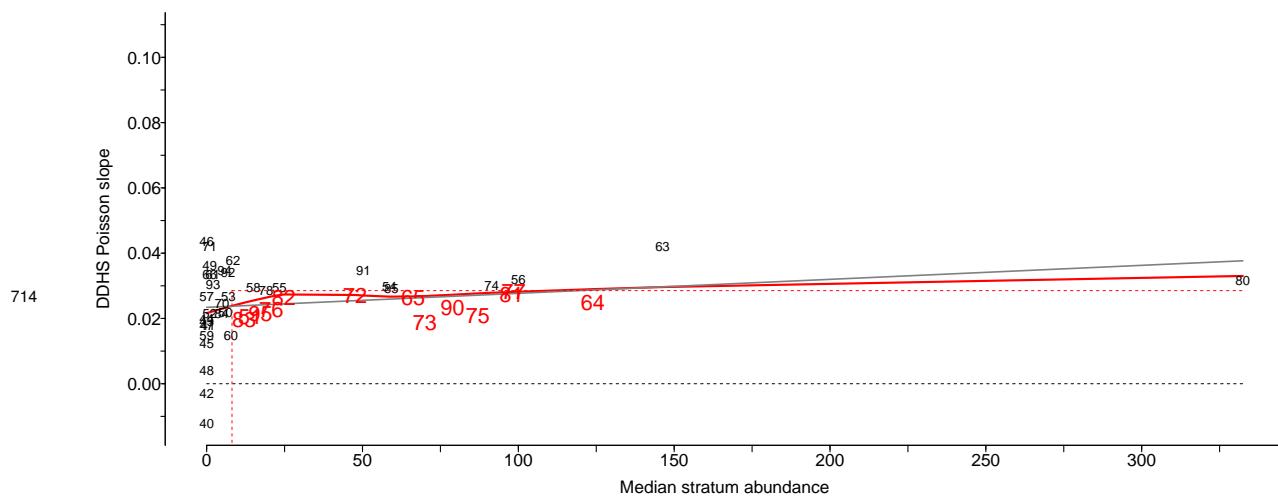


713



Freq	Depth	Temp	Sal
F5	27	1.1	31.00
F25	49	3.0	32.45
F50	66	5.5	33.14
F75	87	7.9	34.36
F95	127	10.0	35.03

Figure 7.2E. Catch distribution by depth, temperature and salinity of Haddock.



714

Figure 7.2F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Haddock.

715

### 7.3 White hake (Merluche blanche) - species code 12 (category LF)

716

Scientific name: [Urophycis tenuis](#)

717

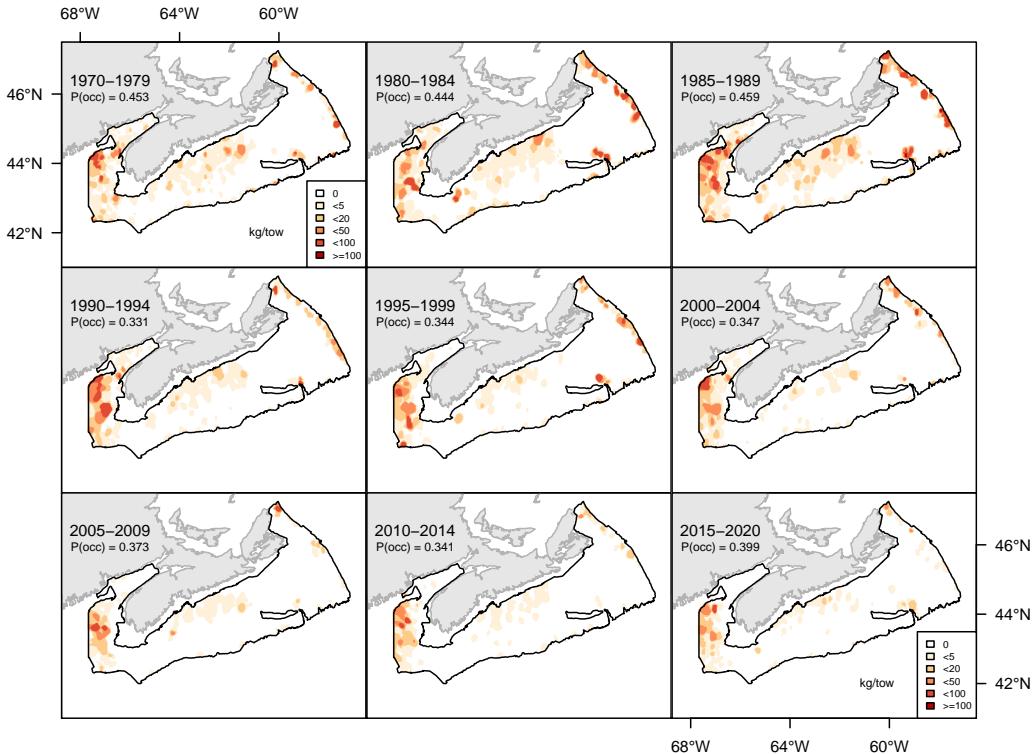


Figure 7.3A. Inverse distance weighted distribution of catch biomass (kg/tow) for White hake.

718

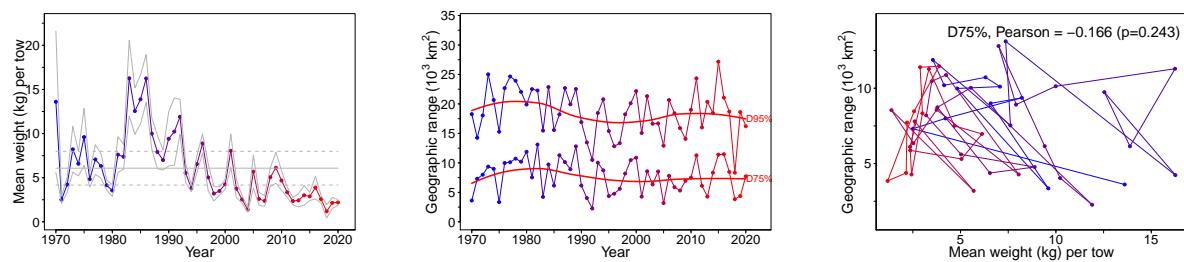


Figure 7.3B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of White hake.

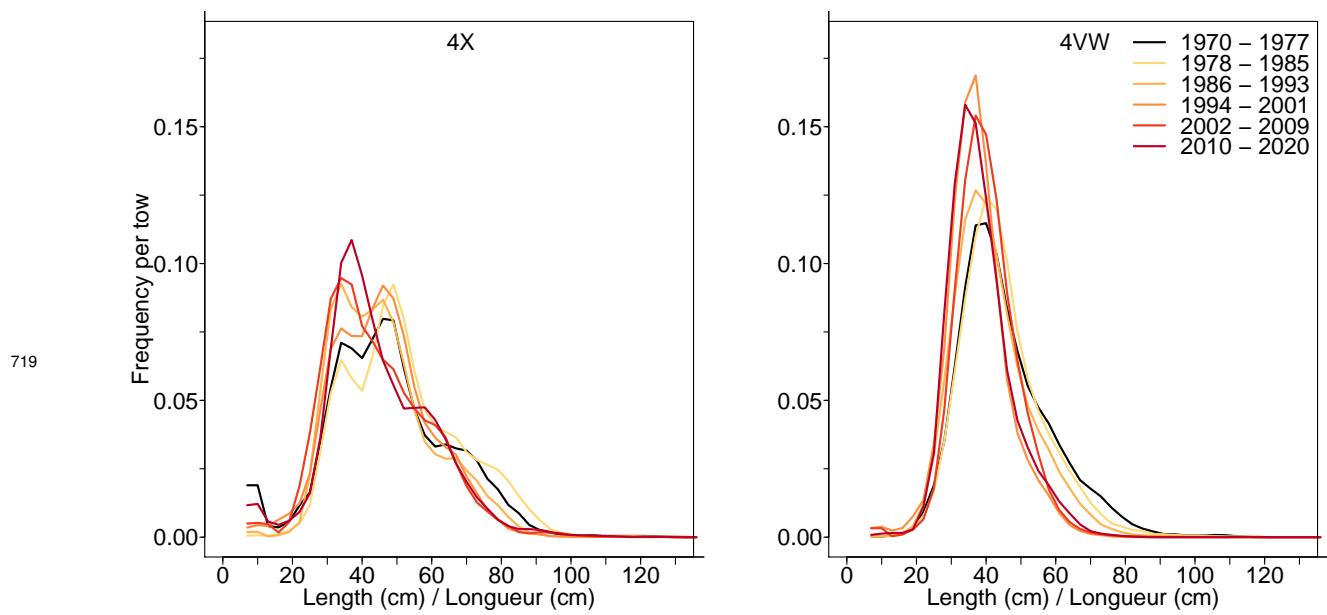


Figure 7.3C. Length frequency distribution in NAFO units 4X and 4VW for White hake.

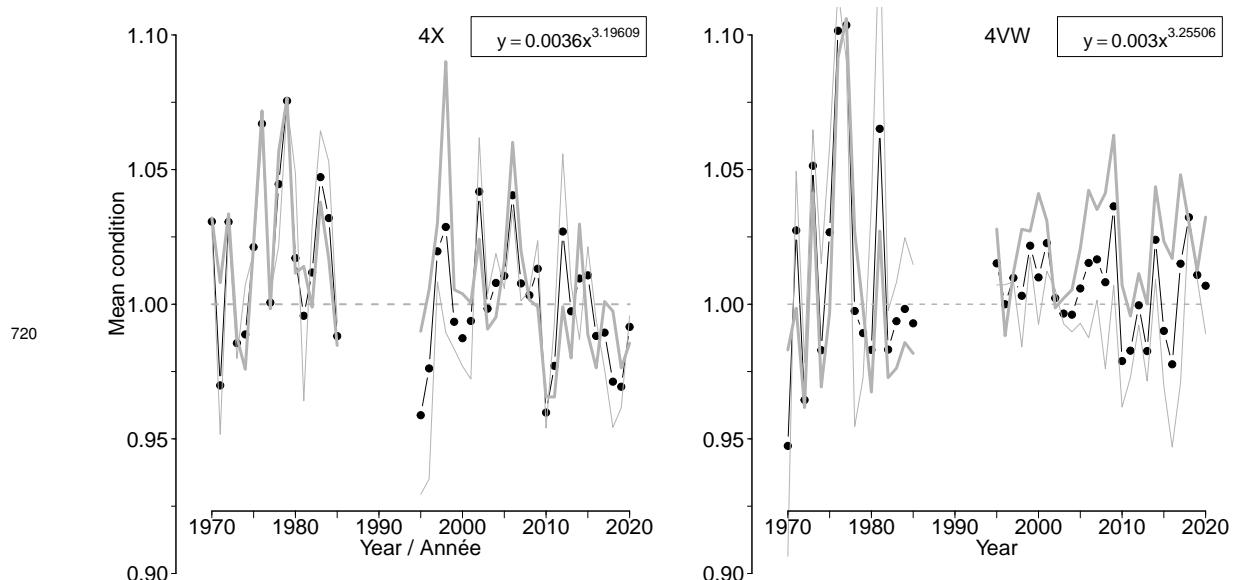
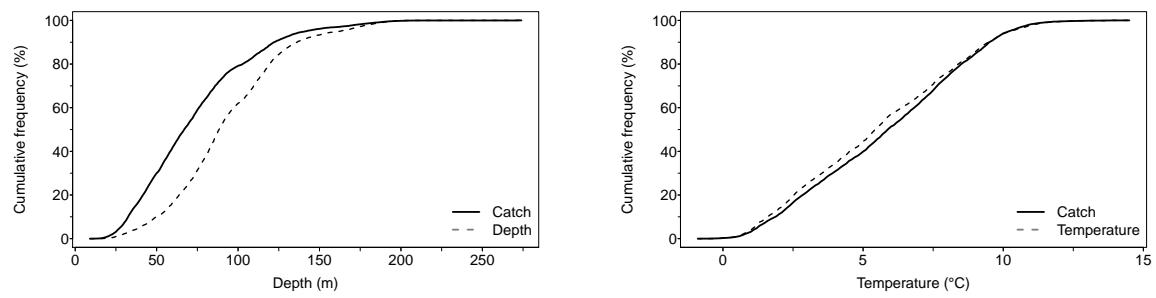
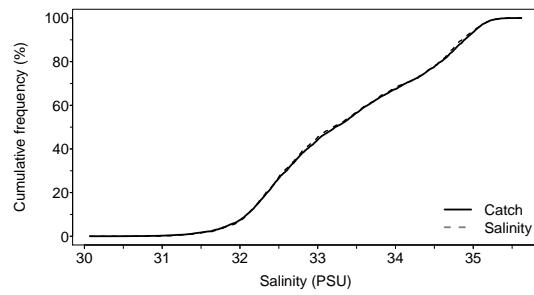


Figure 7.3D. Average fish condition in NAFO units 4X and 4VW for White hake.



721



Freq	Depth	Temp	Sal
F5	40	1.1	31.00
F25	70	3.0	32.46
F50	89	5.5	33.20
F75	115	7.9	34.39
F95	163	10.0	35.04

Figure 7.3E. Catch distribution by depth, temperature and salinity of White hake.

722

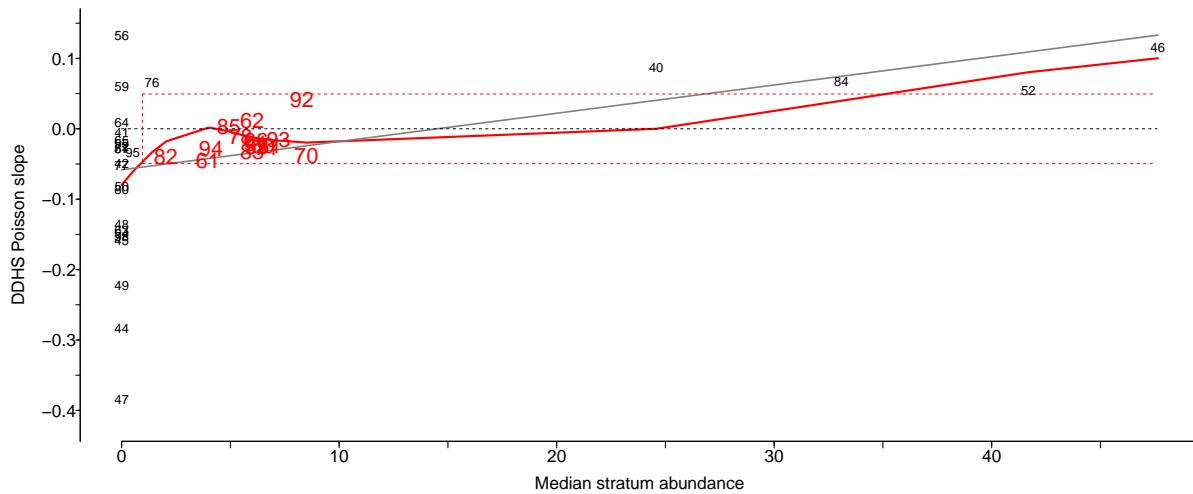


Figure 7.3F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for White hake.

723

#### 7.4 Red hake (Merluche écureuil) - species code 13 (category LF)

724

Scientific name: [Urophycis chuss](#)

725

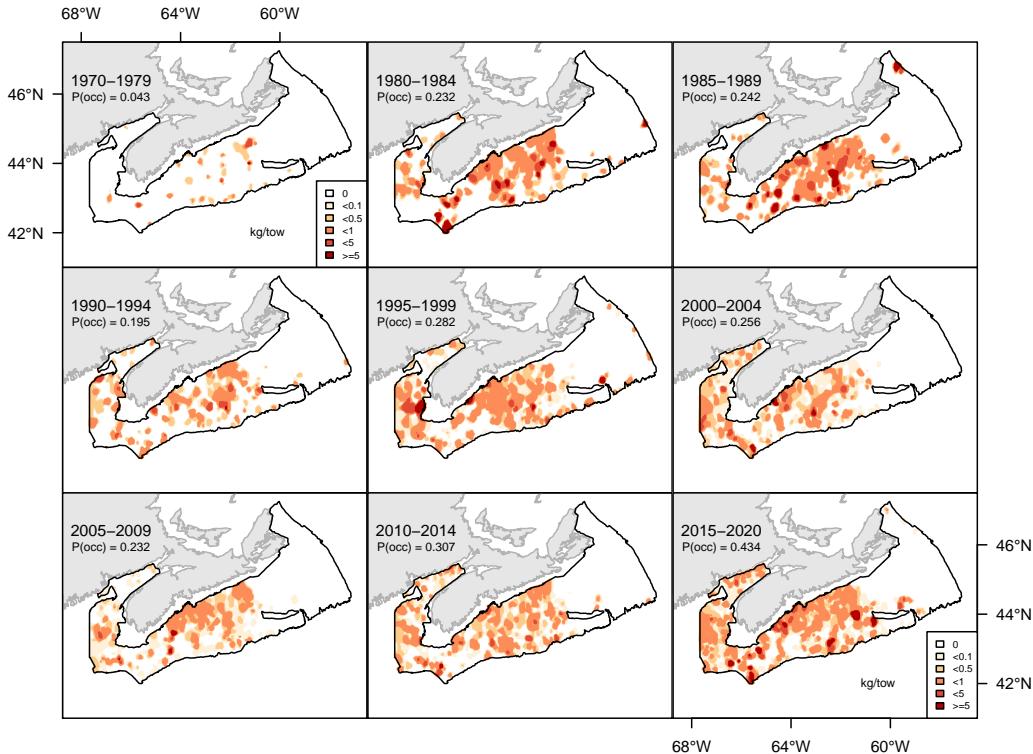


Figure 7.4A. Inverse distance weighted distribution of catch biomass (kg/tow) for Red hake.

726

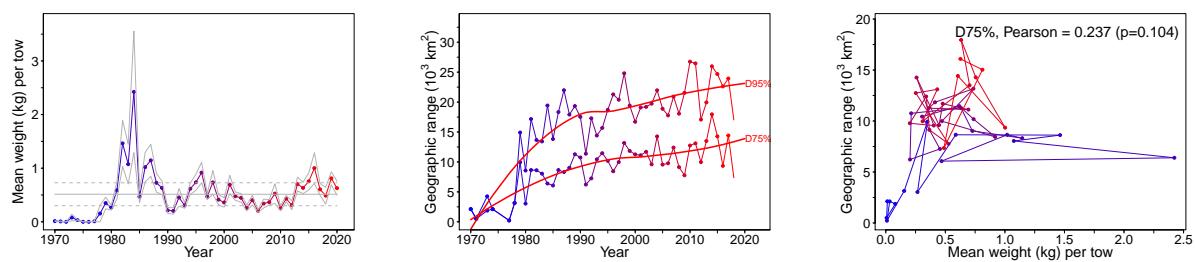


Figure 7.4B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Red hake.

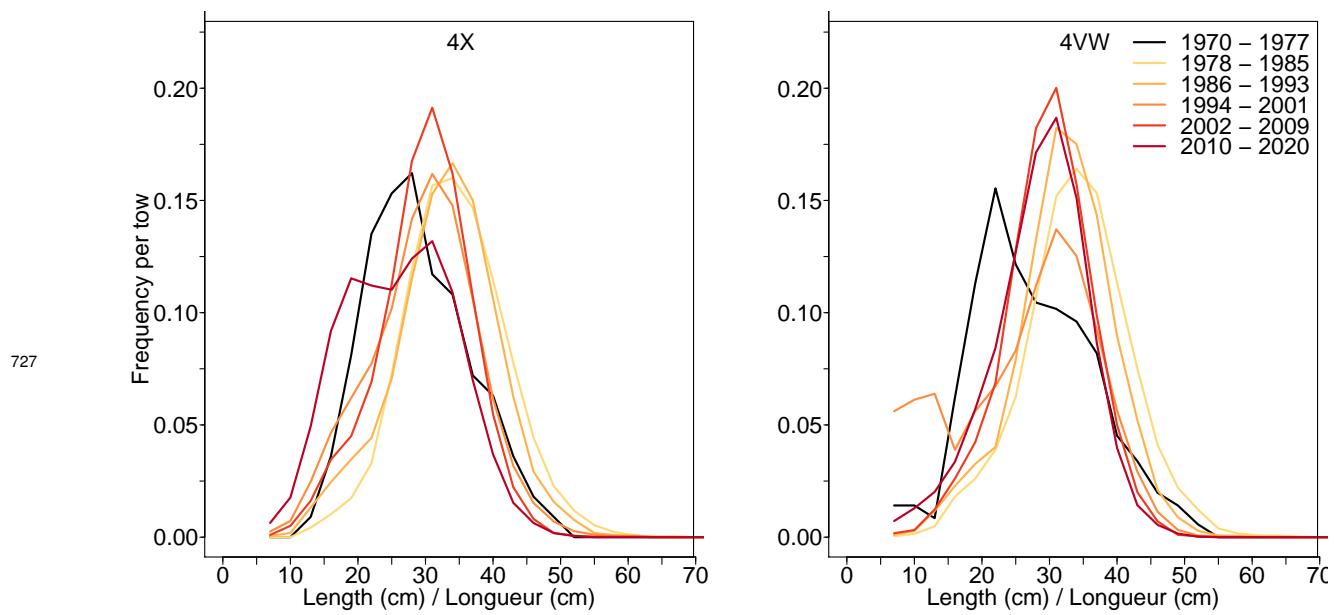


Figure 7.4C. Length frequency distribution in NAFO units 4X and 4VW for Red hake.

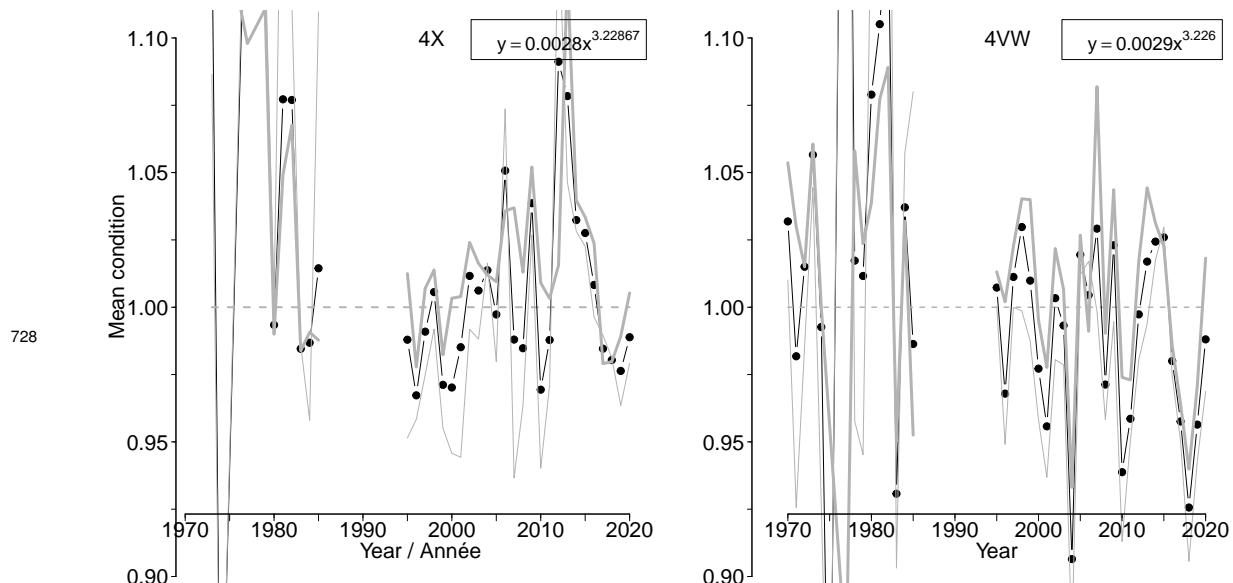
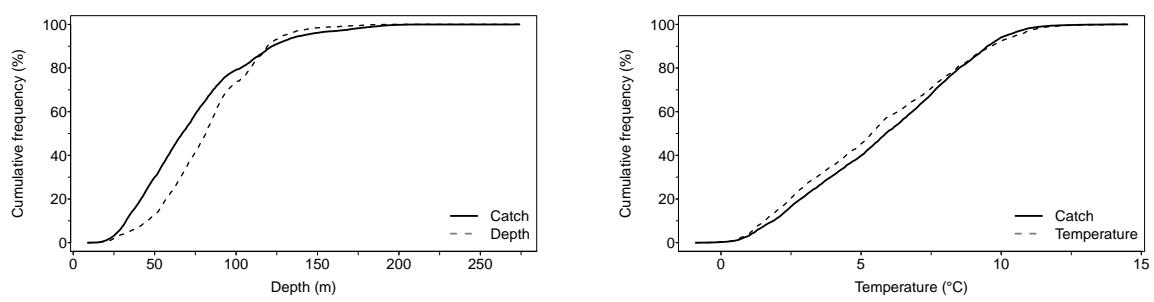
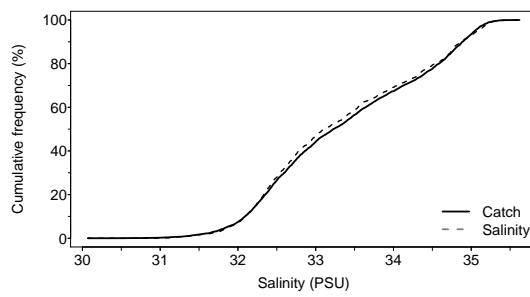


Figure 7.4D. Average fish condition in NAFO units 4X and 4VW for Red hake.



729



Freq	Depth	Temp	Sal
F5	35	1.1	31.00
F25	62	2.9	32.43
F50	82	5.4	33.12
F75	103	7.9	34.32
F95	130	10.0	35.08

Figure 7.4E. Catch distribution by depth, temperature and salinity of Red hake.

730

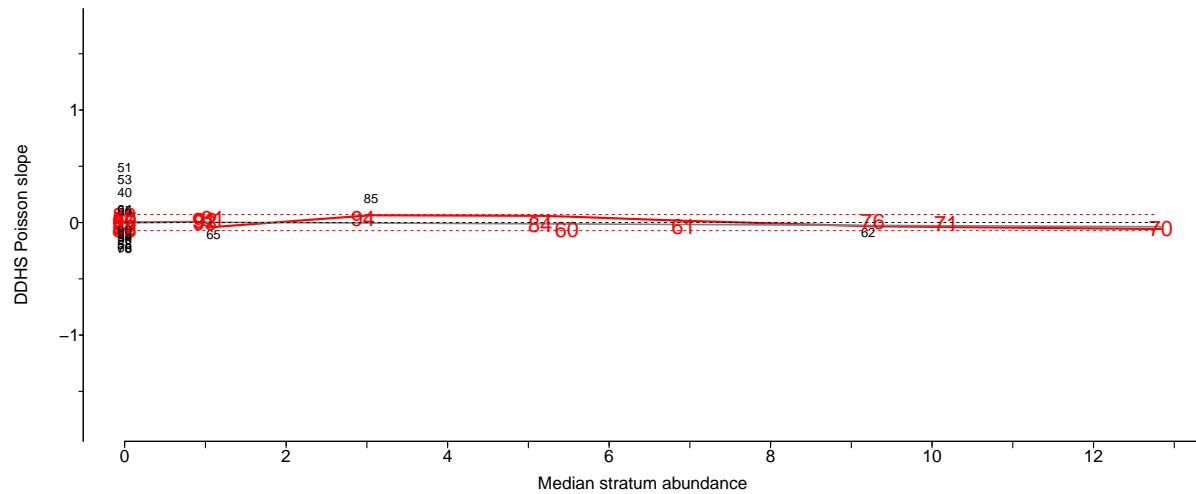


Figure 7.4F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Red hake.

731

## 7.5 Silver hake (*Merlu argenté*) - species code 14 (category LF)

732

Scientific name: [Merluccius bilinearis](#)

733

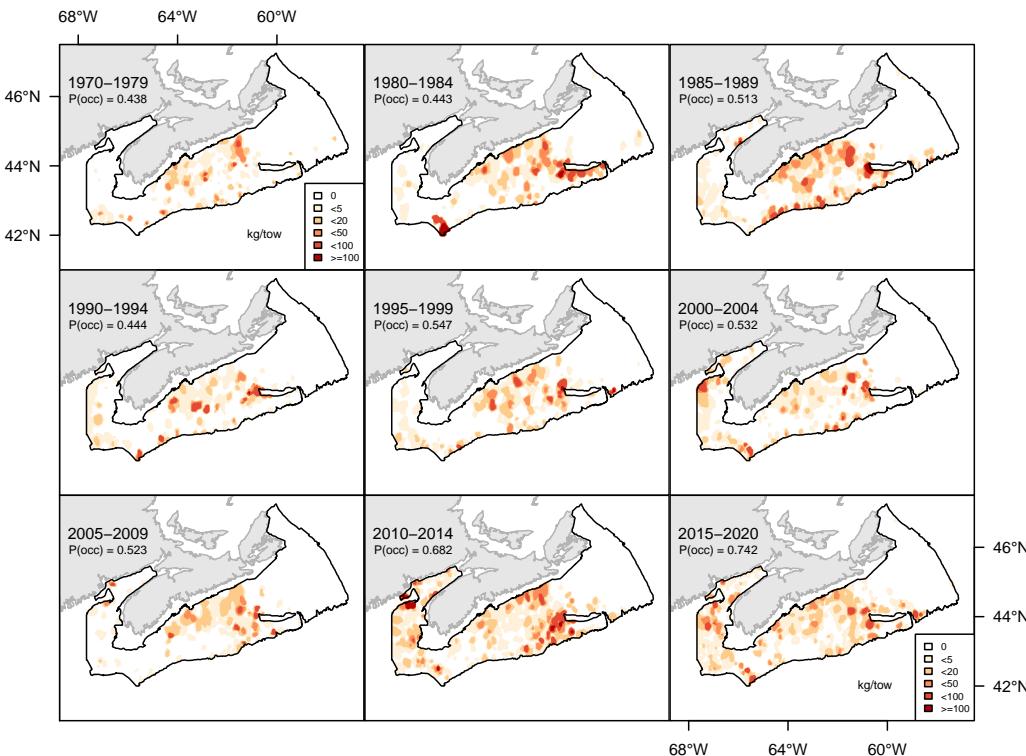


Figure 7.5A. Inverse distance weighted distribution of catch biomass (kg/tow) for Silver hake.

734

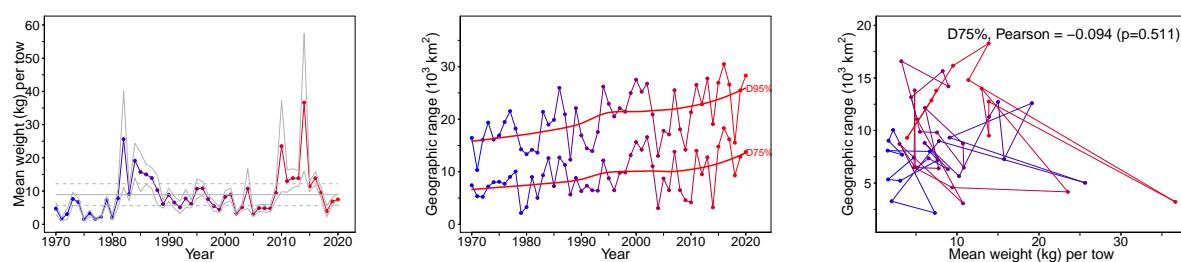


Figure 7.5B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Silver hake.

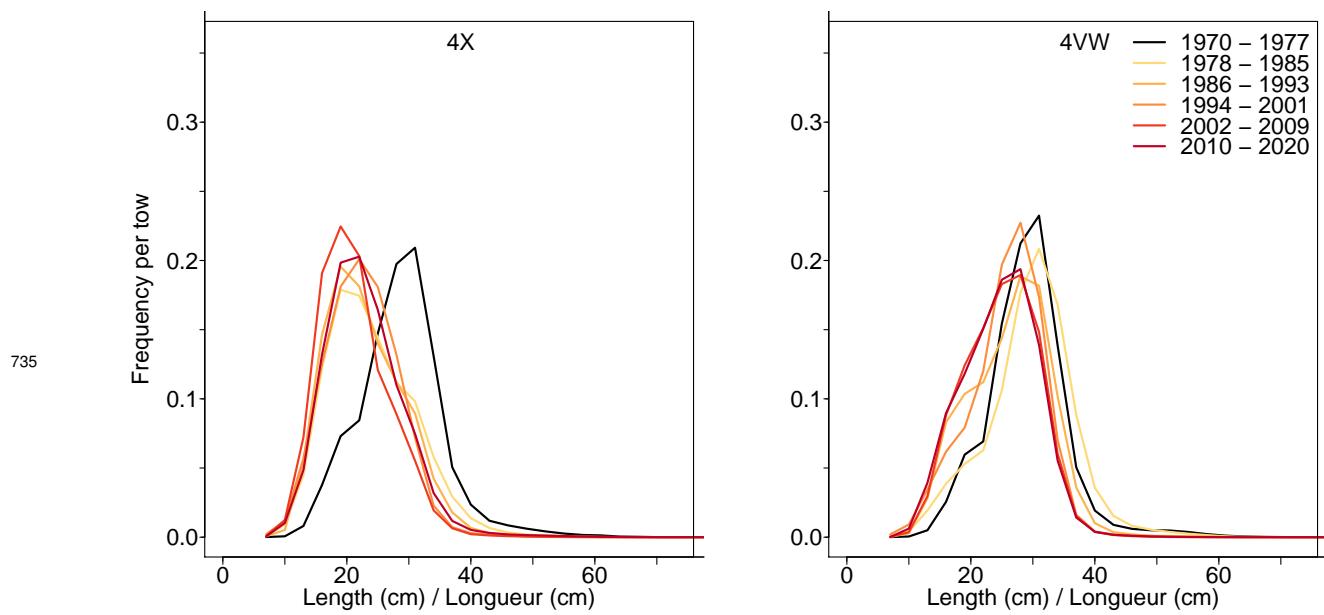


Figure 7.5C. Length frequency distribution in NAFO units 4X and 4VW for Silver hake.

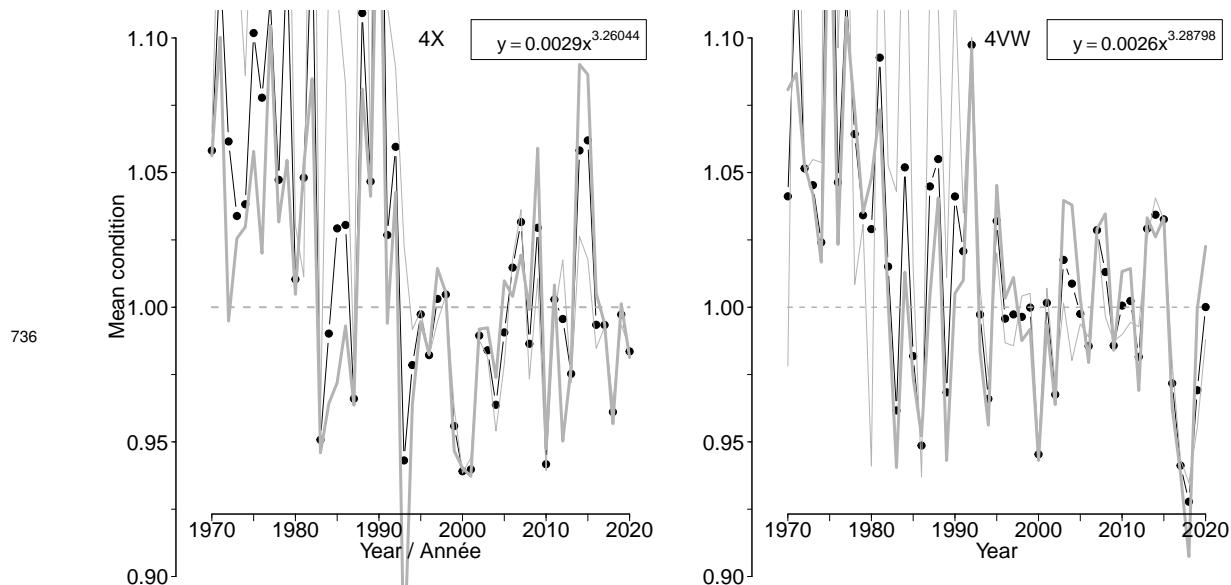
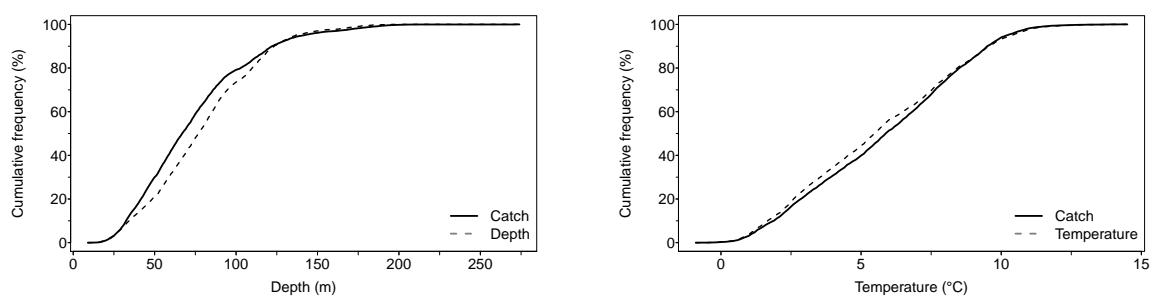
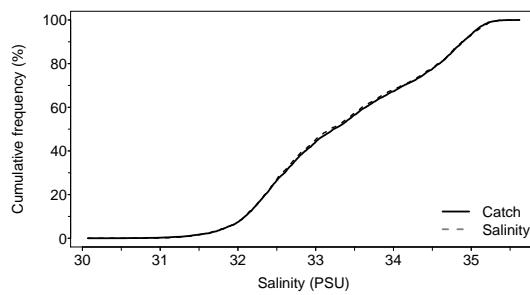


Figure 7.5D. Average fish condition in NAFO units 4X and 4VW for Silver hake.



737



Freq	Depth	Temp	Sal
F5	28	1.2	31.00
F25	55	3.1	32.46
F50	77	5.5	33.20
F75	104	8.0	34.37
F95	137	10.0	35.07

Figure 7.5E. Catch distribution by depth, temperature and salinity of Silver hake.

738

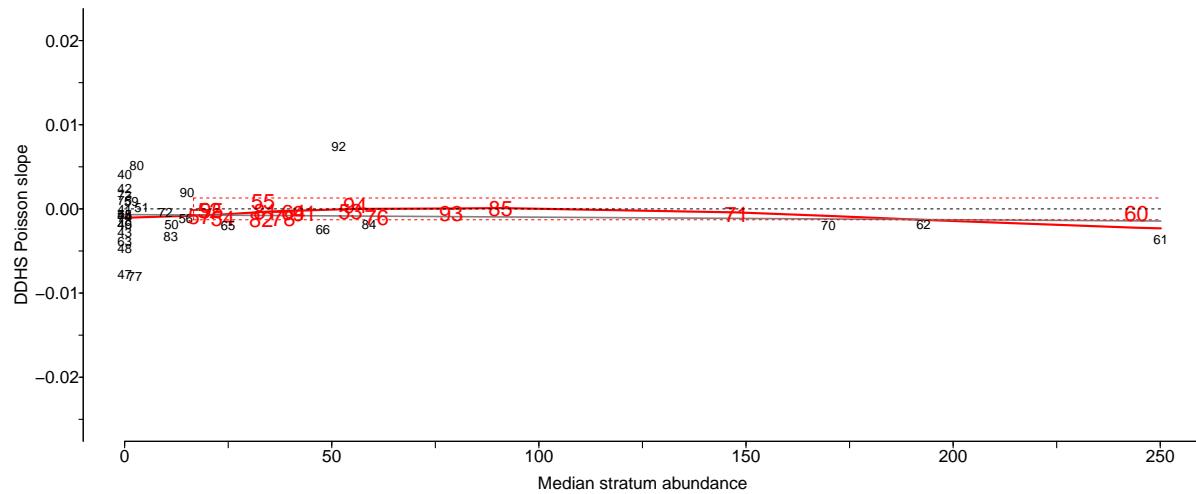


Figure 7.5F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Silver hake.

739

## 7.6 Pollock (Goberge) - species code 16 (category LF)

740

Scientific name: [Pollachius virens](#)

741

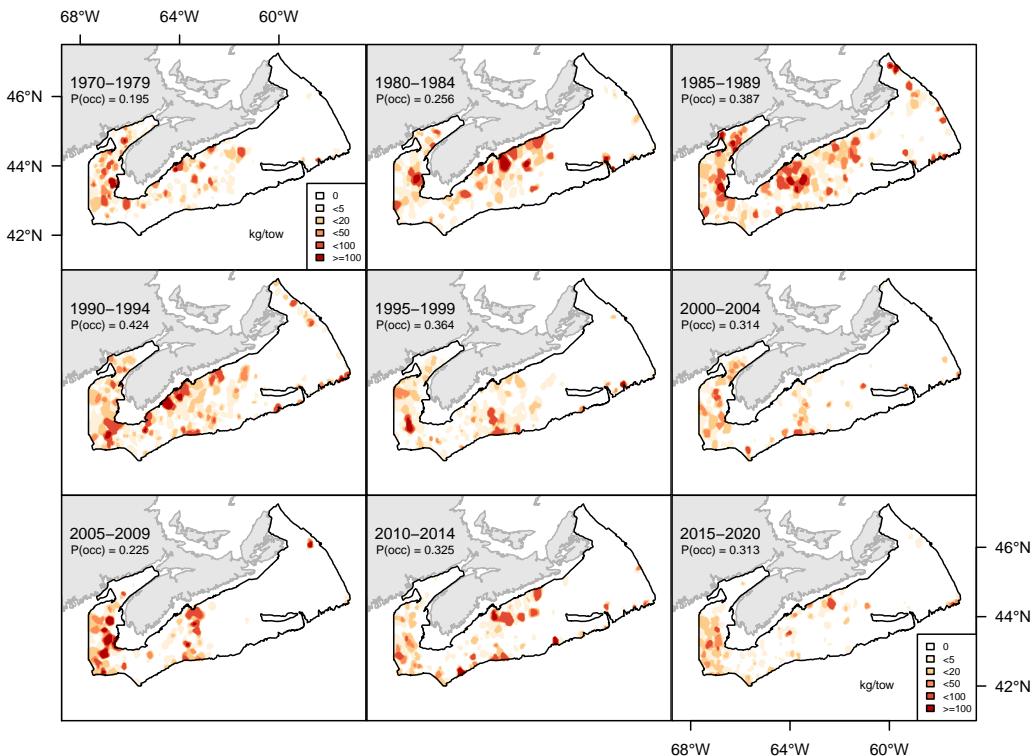


Figure 7.6A. Inverse distance weighted distribution of catch biomass (kg/tow) for Pollock.

742

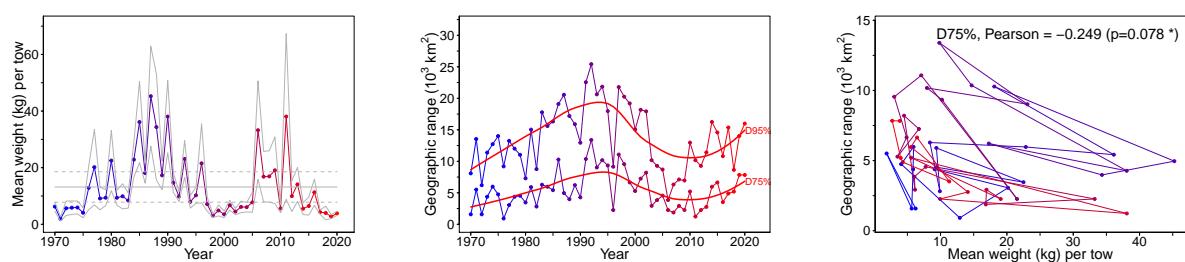


Figure 7.6B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Pollock.

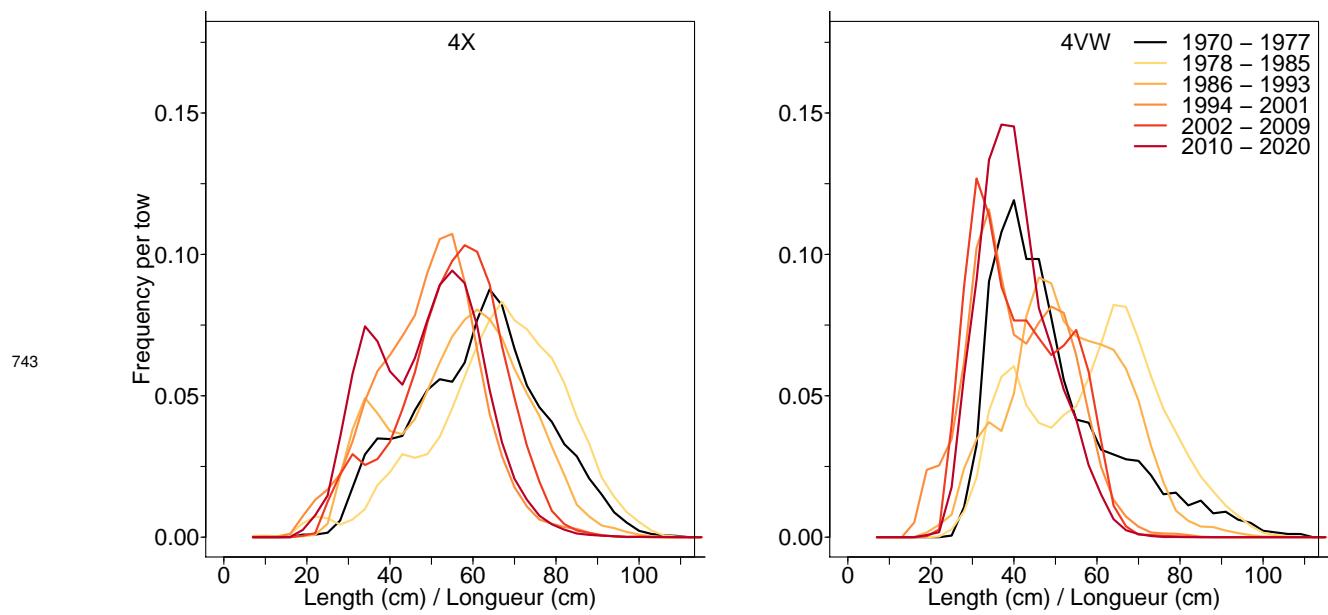


Figure 7.6C. Length frequency distribution in NAFO units 4X and 4VW for Pollock.

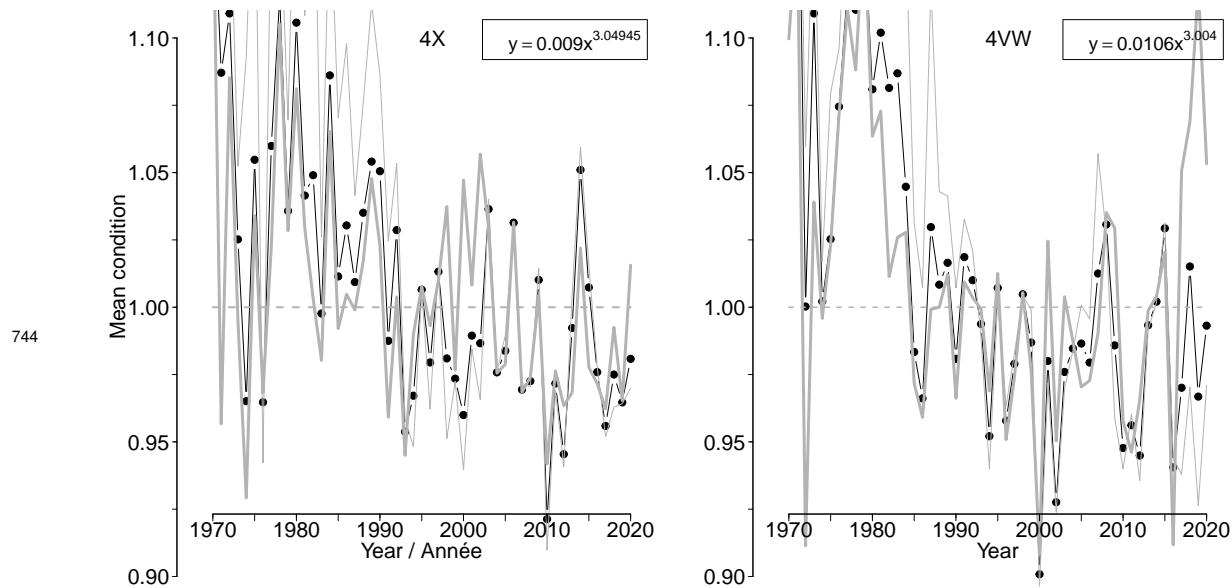
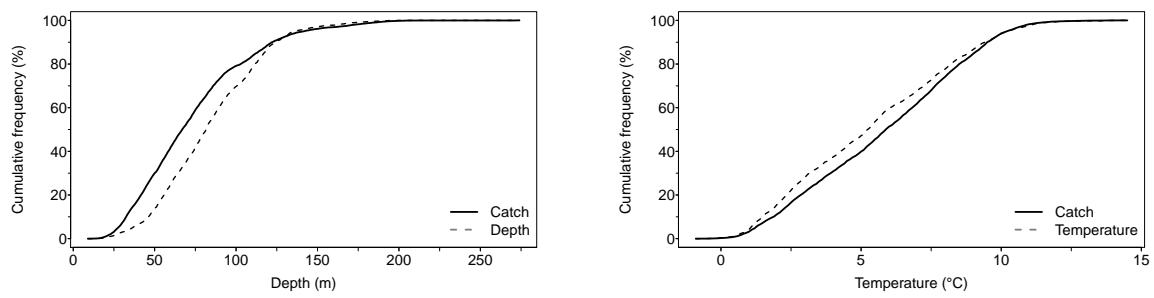
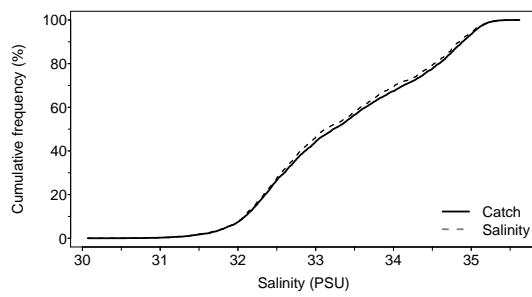


Figure 7.6D. Average fish condition in NAFO units 4X and 4VW for Pollock.



745



Freq	Depth	Temp	Sal
F5	37	1.1	31.00
F25	60	2.8	32.45
F50	82	5.3	33.14
F75	108	7.7	34.33
F95	137	10.0	35.03

Figure 7.6E. Catch distribution by depth, temperature and salinity of Pollock.

746

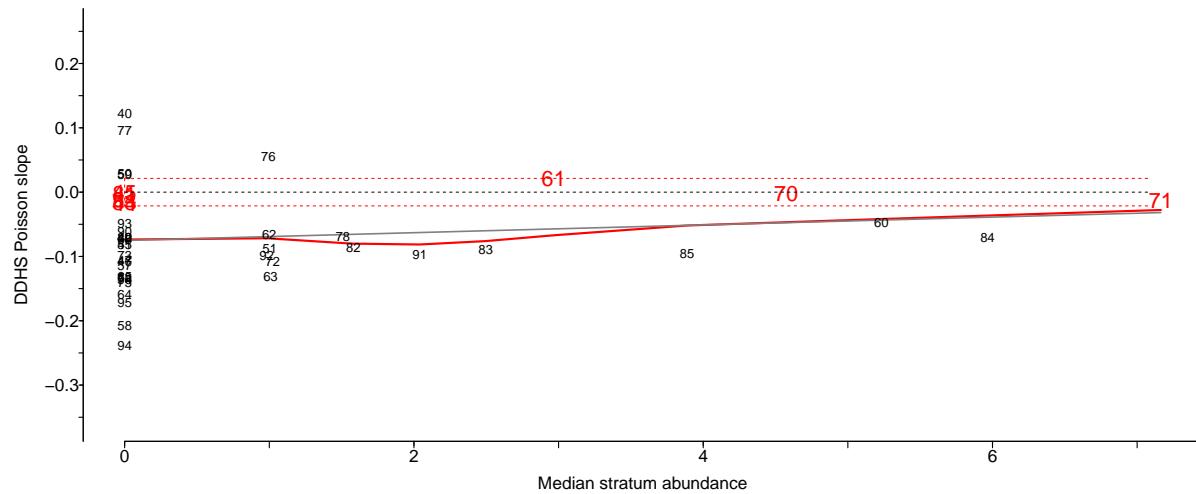


Figure 7.6F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Pollock.

747

## 7.7 Atlantic redfishes (Sébastes de l'Atlantique) - species code 23 (category LF)

748

Scientific name: [Sebastes](#)

749

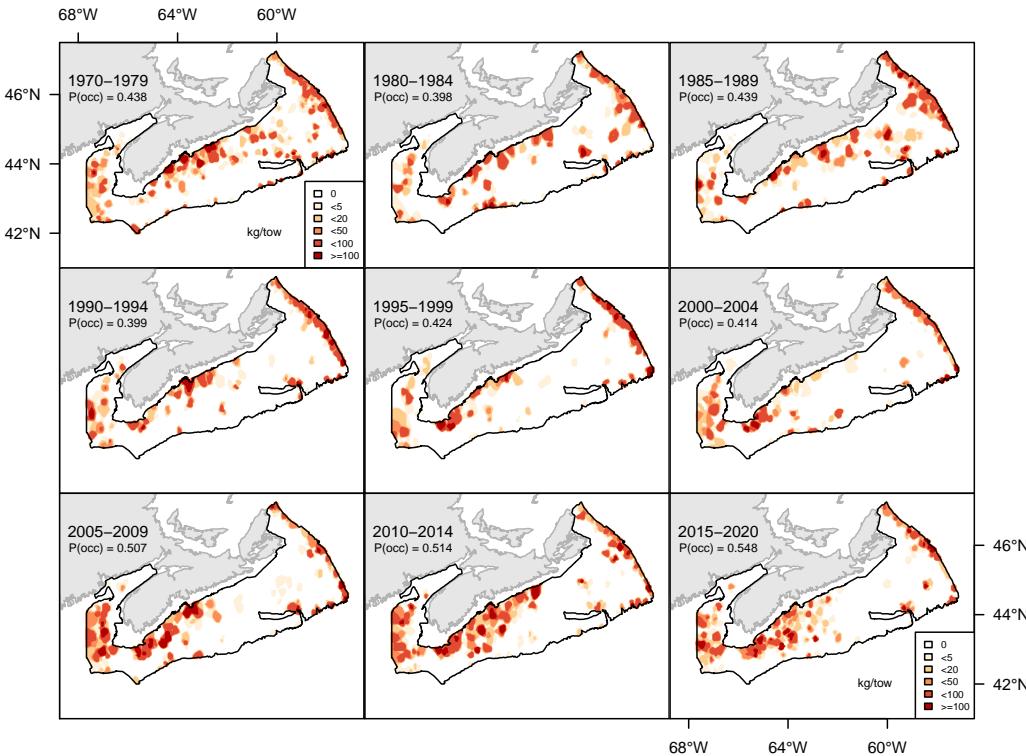


Figure 7.7A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic redfishes.

750

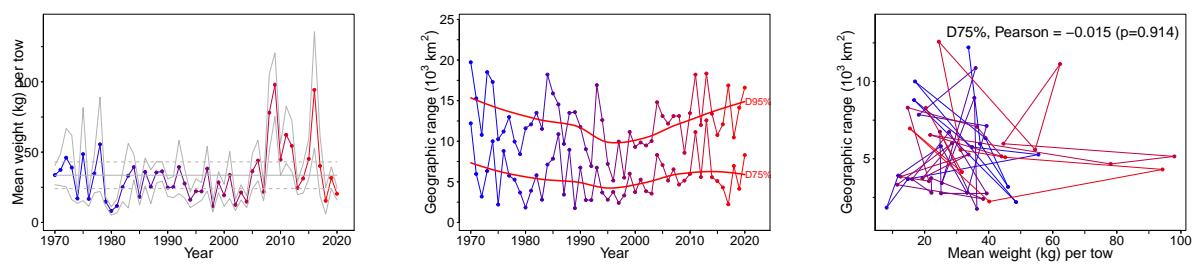


Figure 7.7B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic redfishes.

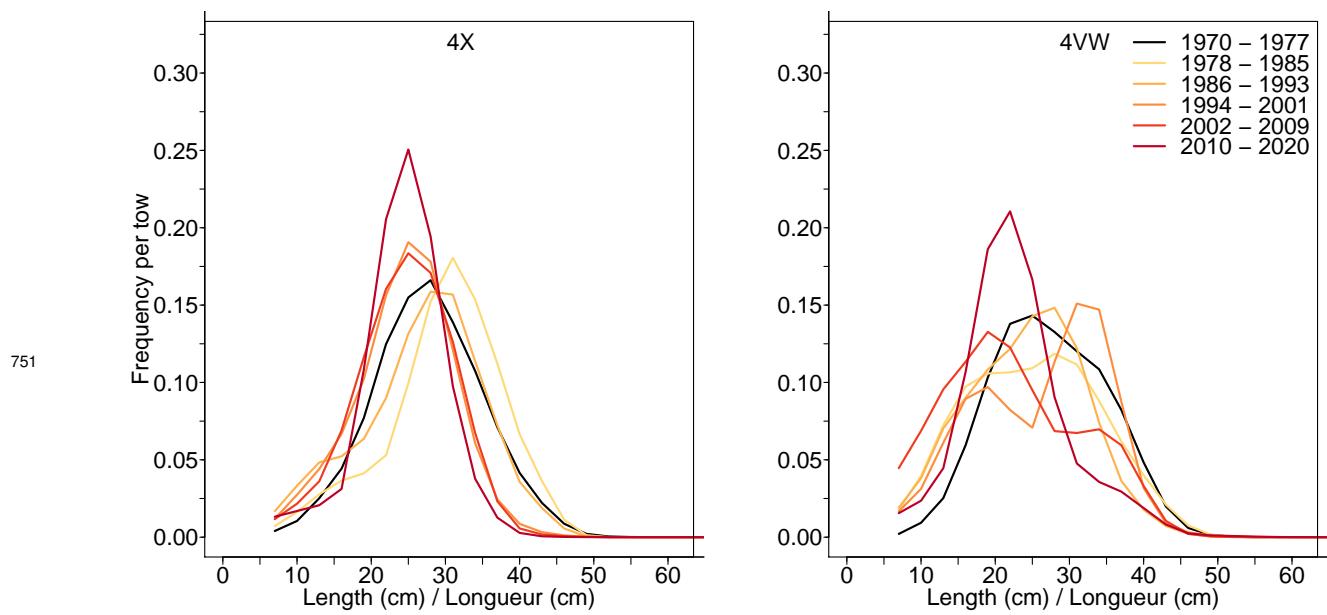


Figure 7.7C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic redfishes.

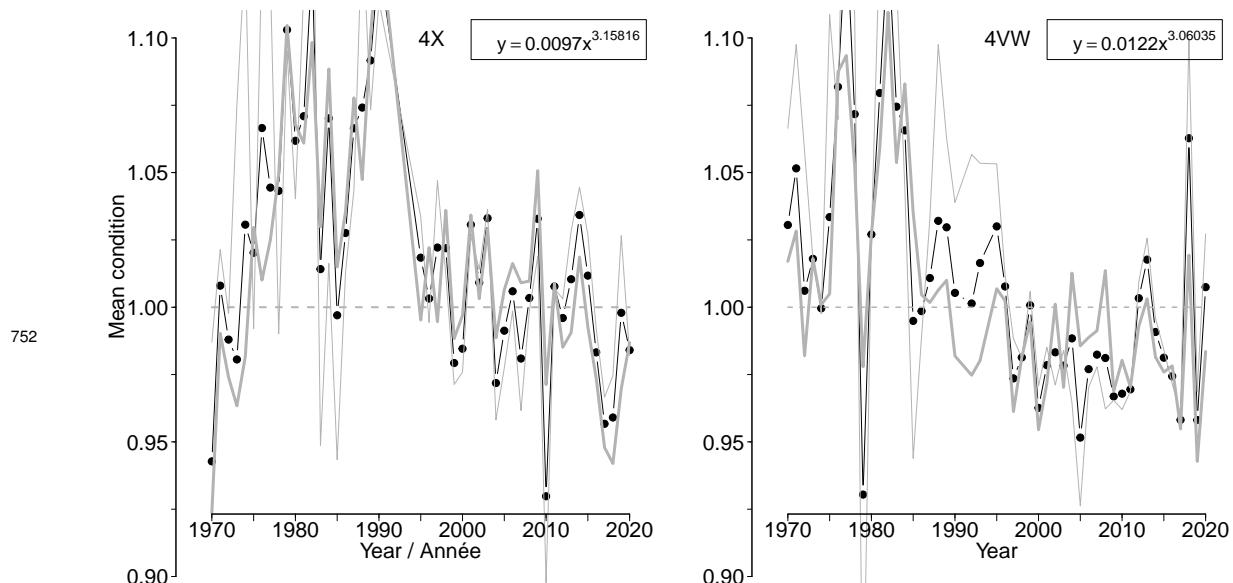
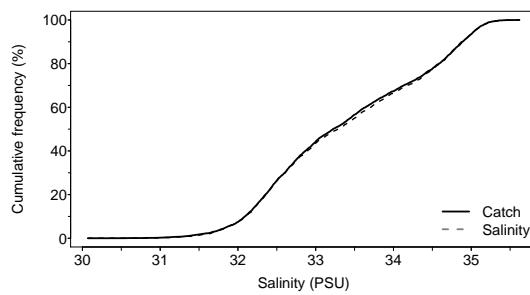
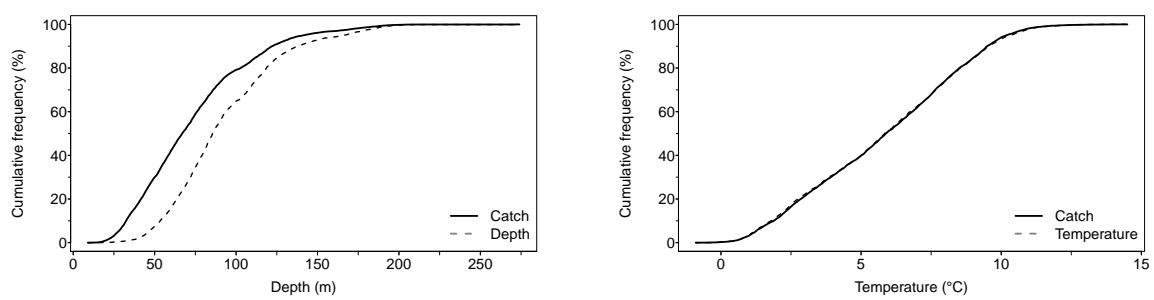


Figure 7.7D. Average fish condition in NAFO units 4X and 4VW for Atlantic redfishes.



Freq	Depth	Temp	Sal
F5	47	1.2	31.00
F25	68	3.4	32.48
F50	86	5.9	33.29
F75	114	8.1	34.41
F95	166	10.0	35.05

Figure 7.7E. Catch distribution by depth, temperature and salinity of Atlantic redfishes.

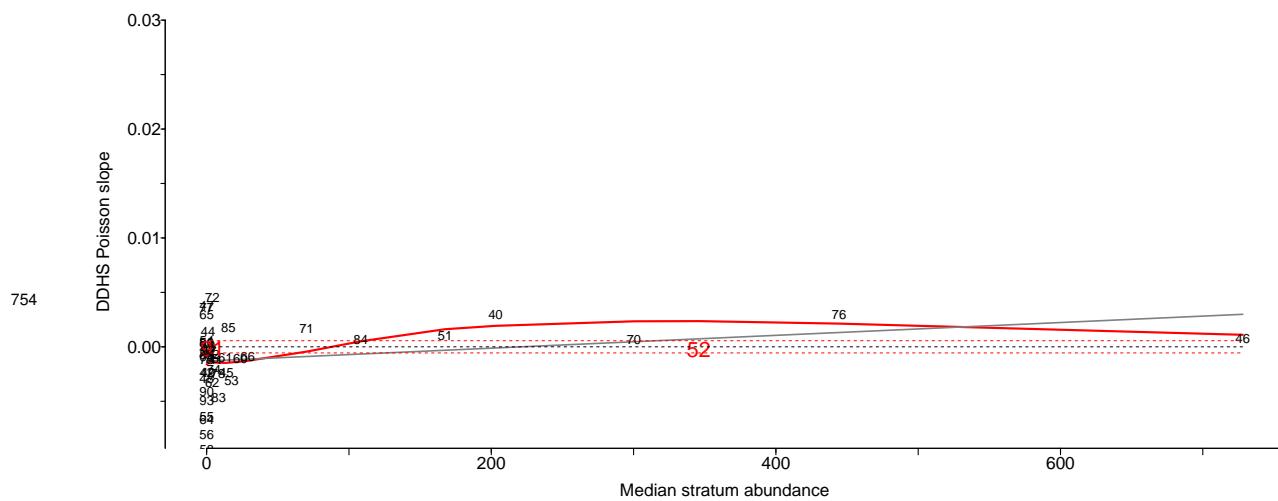


Figure 7.7F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic redfishes.

755

## 7.8 Atlantic halibut (Flétan de l'Atlantique) - species code 30 (category LF)

756

Scientific name: [Hippoglossus hippoglossus](#)

757

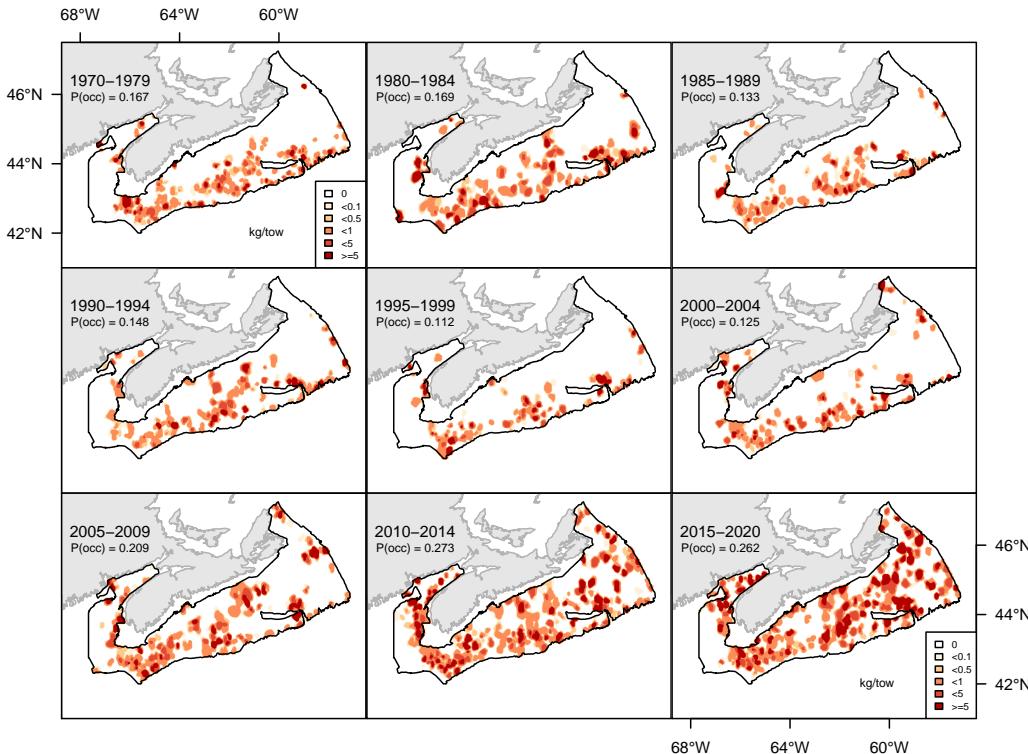


Figure 7.8A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic halibut.

758

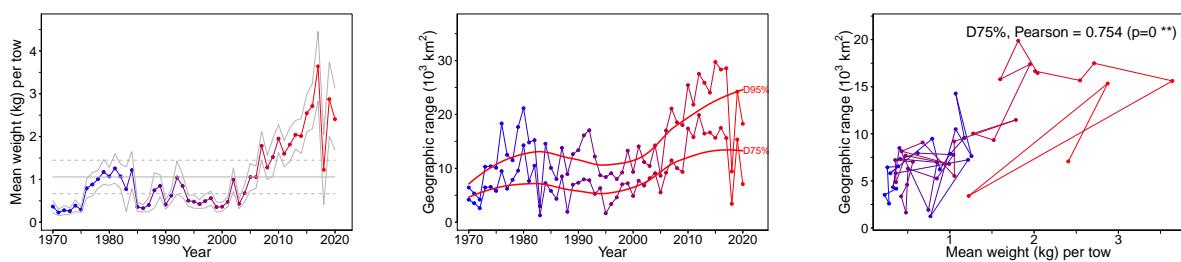


Figure 7.8B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic halibut.

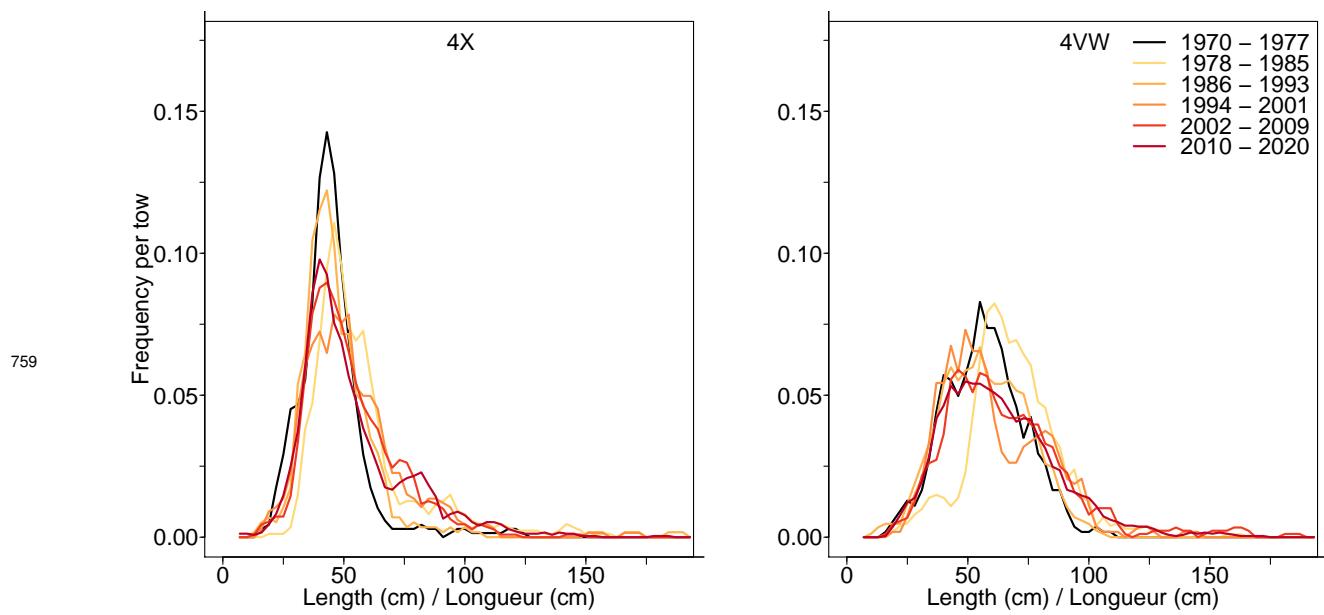


Figure 7.8C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic halibut.

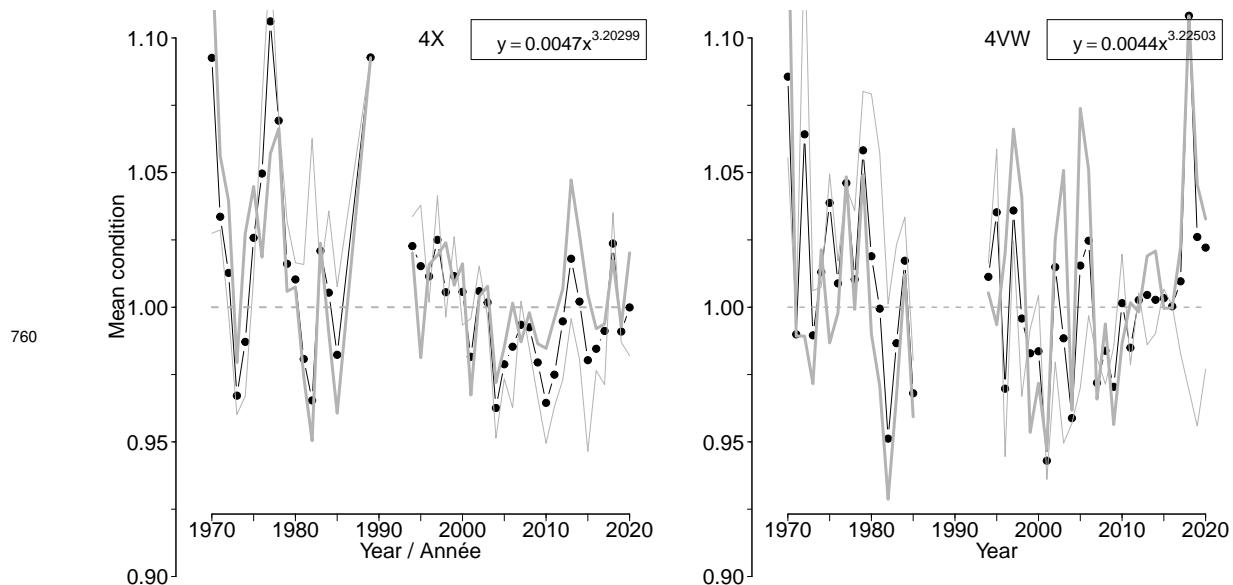
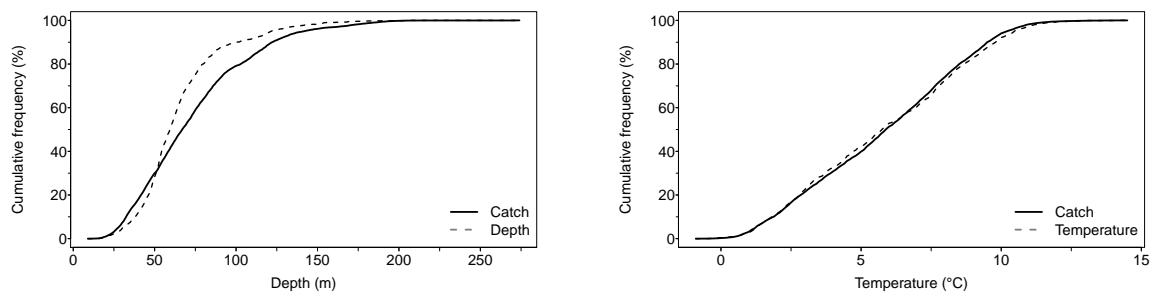
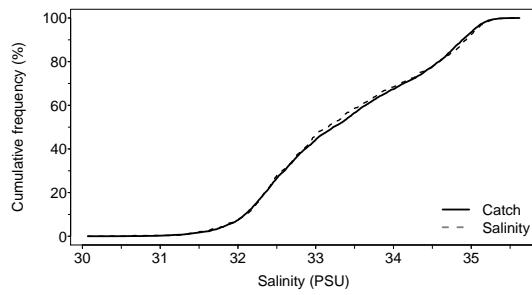


Figure 7.8D. Average fish condition in NAFO units 4X and 4VW for Atlantic halibut.



761



Freq	Depth	Temp	Sal
F5	31	1.3	31.00
F25	49	3.2	32.45
F50	60	5.8	33.16
F75	75	8.3	34.34
F95	122	10.0	35.08

Figure 7.8E. Catch distribution by depth, temperature and salinity of Atlantic halibut.

762

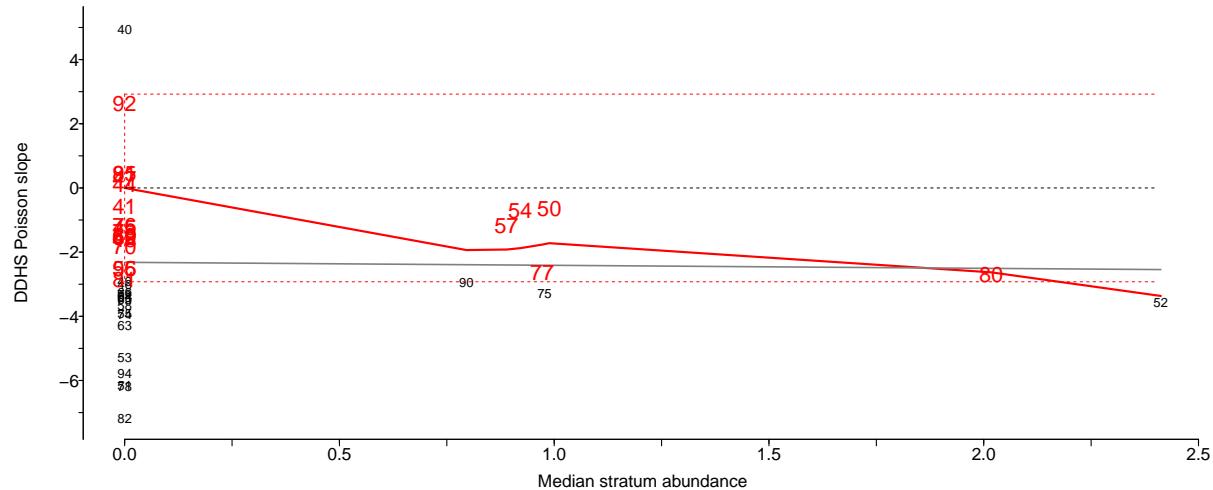


Figure 7.8F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic halibut.

763

## 7.9 American plaice (*Ple canadienne*) - species code 40 (category LF)

764

Scientific name: [Hippoglossoides platessoides](#)

765

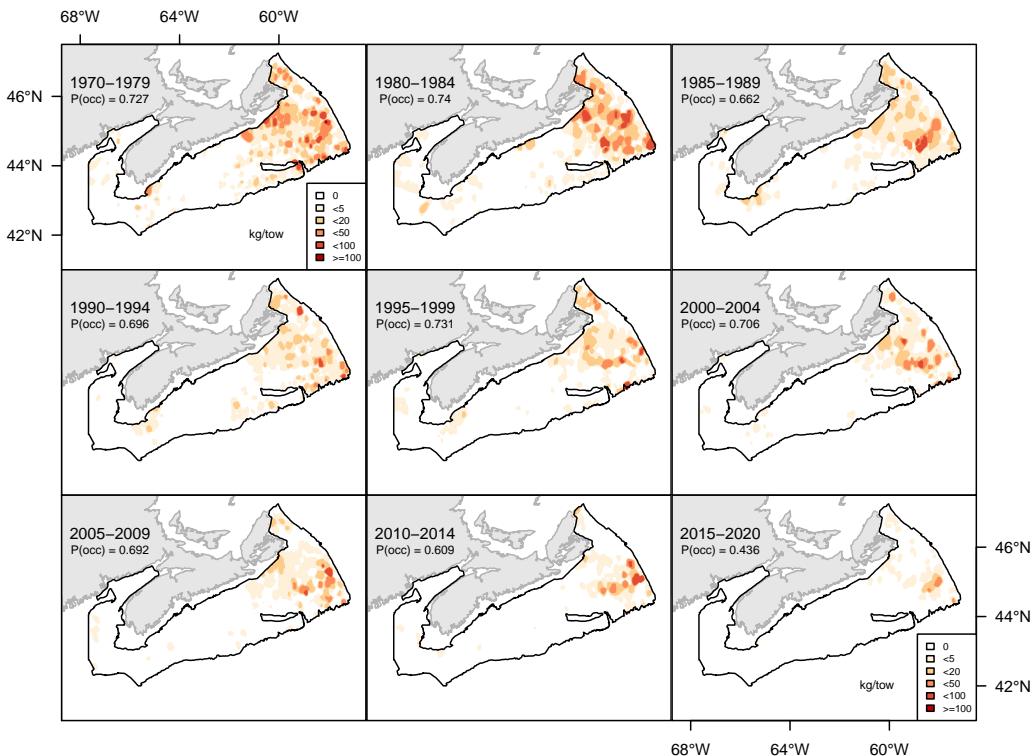


Figure 7.9A. Inverse distance weighted distribution of catch biomass (kg/tow) for American plaice.

766

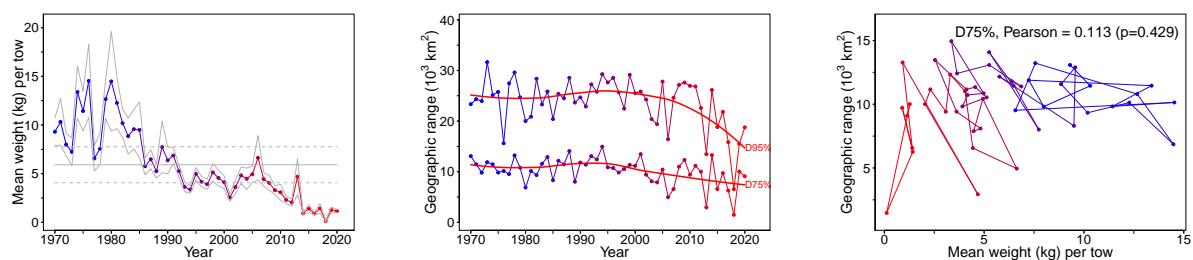


Figure 7.9B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American plaice.

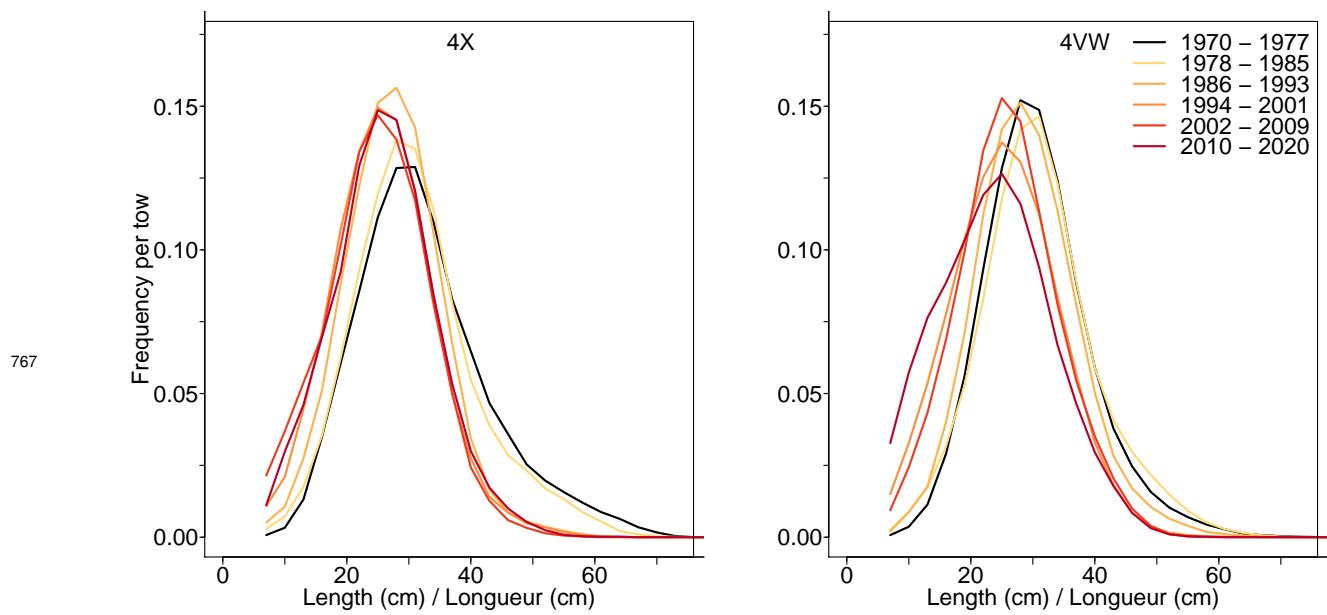


Figure 7.9C. Length frequency distribution in NAFO units 4X and 4VW for American plaice.

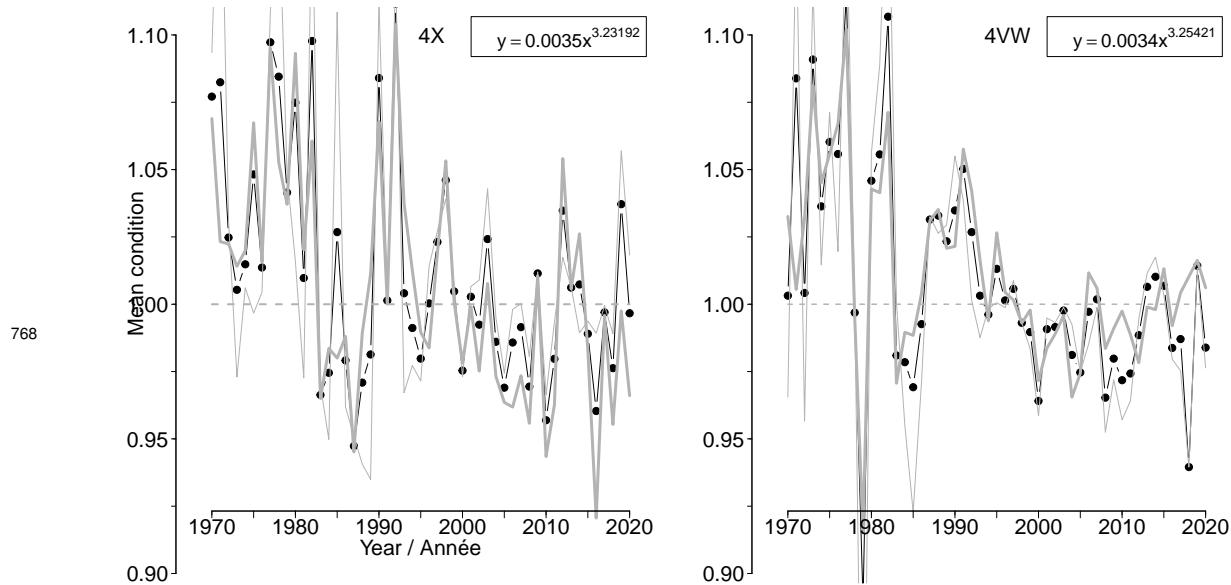
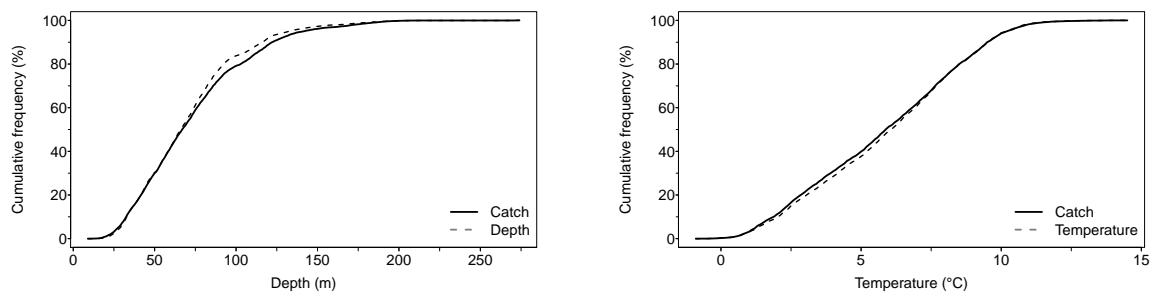
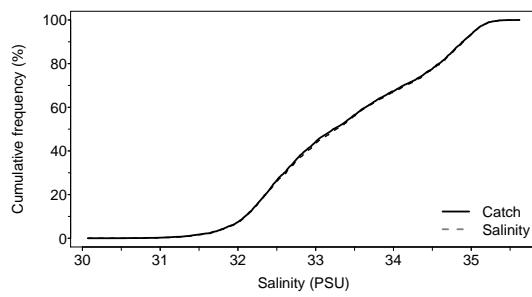


Figure 7.9D. Average fish condition in NAFO units 4X and 4VW for American plaice.



769



Freq	Depth	Temp	Sal
F5	29	1.3	31.00
F25	46	3.7	32.48
F50	67	6.1	33.27
F75	87	8.1	34.41
F95	133	10.0	35.05

Figure 7.9E. Catch distribution by depth, temperature and salinity of American plaice.

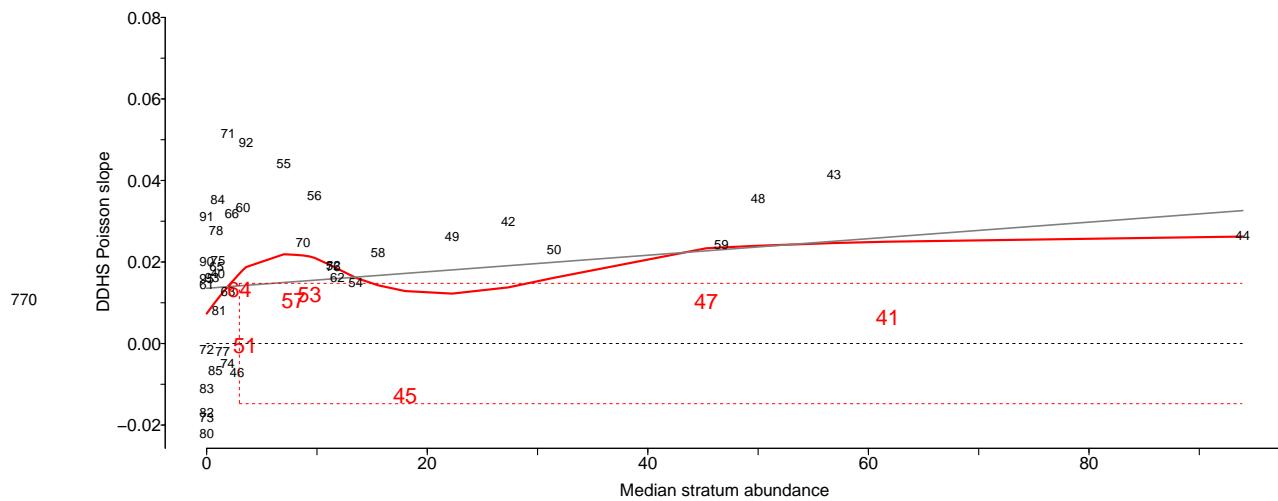


Figure 7.9F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for American plaice.

771

## 7.10 Witch flounder (*Ple grise*) - species code 41 (category LF)

772

Scientific name: [Glyptocephalus cynoglossus](#)

773

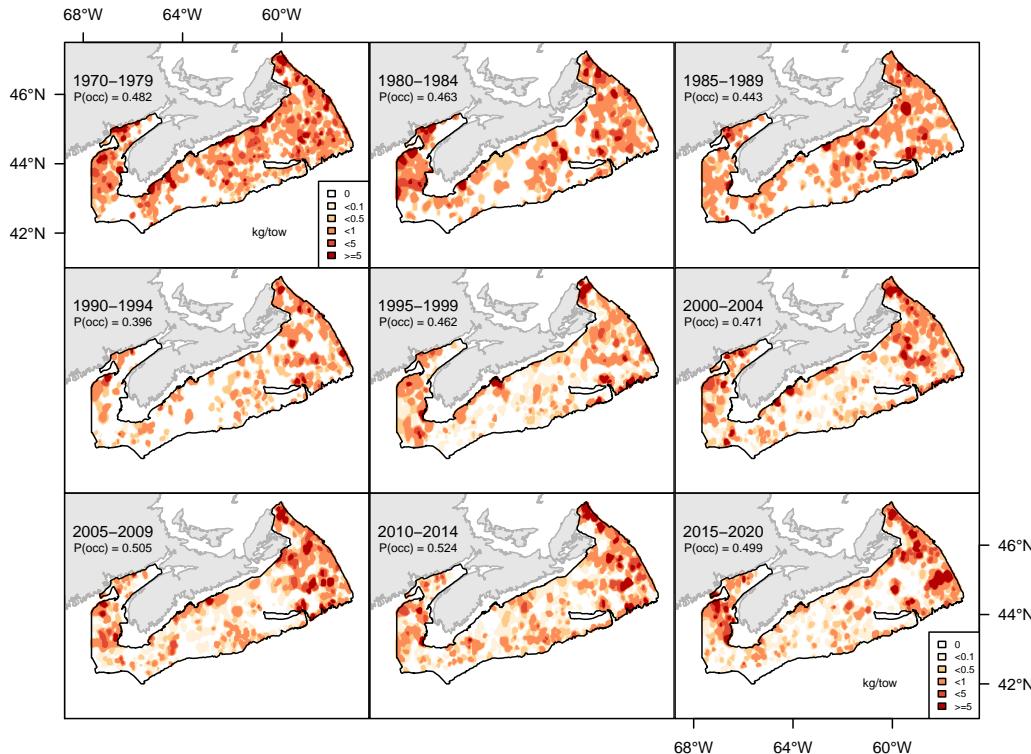


Figure 7.10A. Inverse distance weighted distribution of catch biomass (kg/tow) for Witch flounder.

774

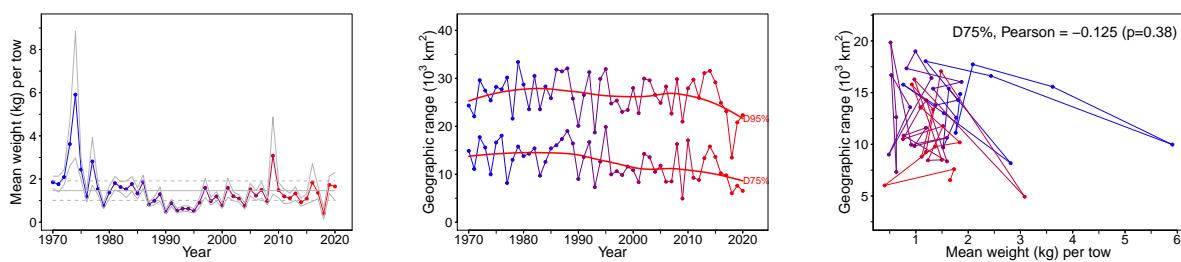


Figure 7.10B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Witch flounder.

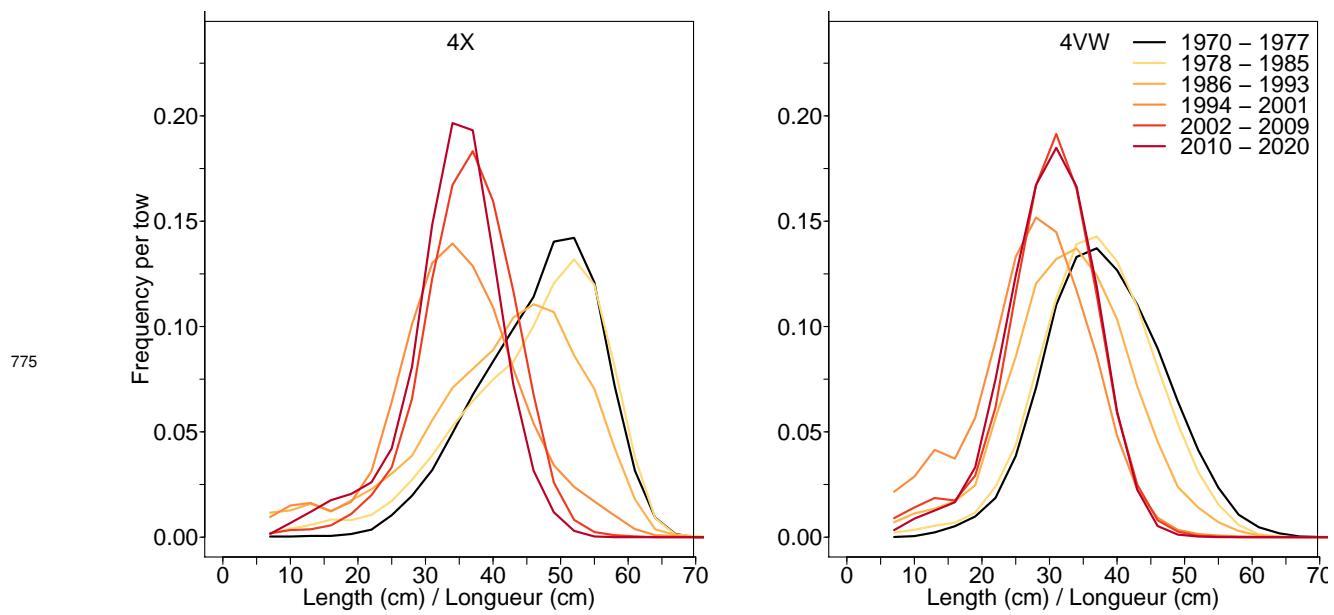


Figure 7.10C. Length frequency distribution in NAFO units 4X and 4VW for Witch flounder.

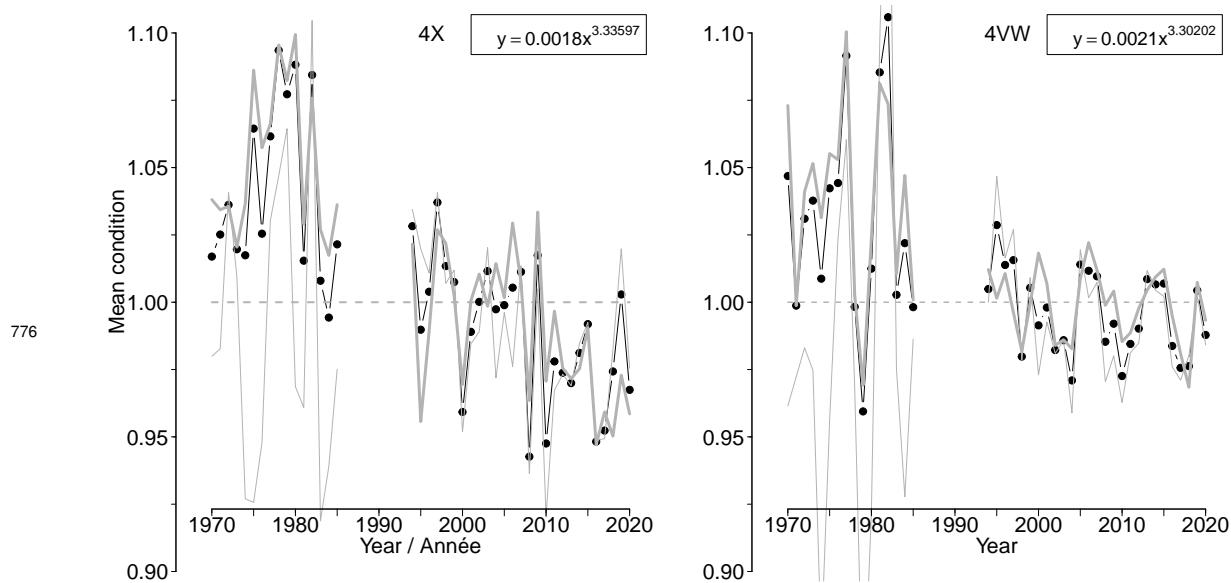
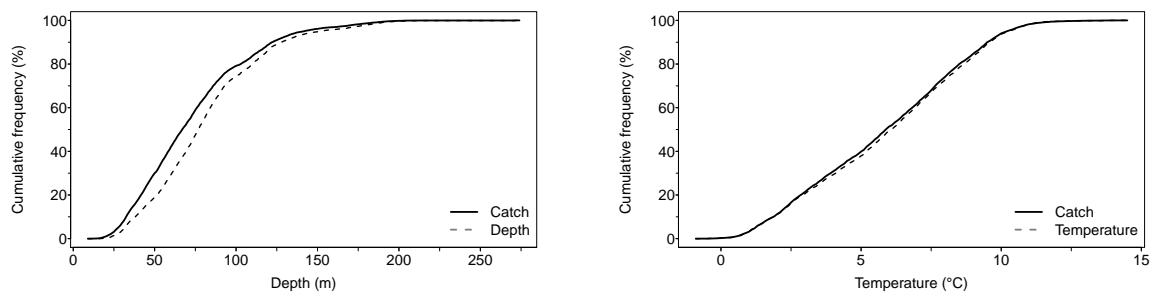
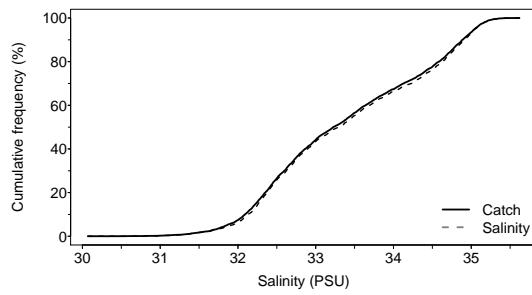


Figure 7.10D. Average fish condition in NAFO units 4X and 4VW for Witch flounder.

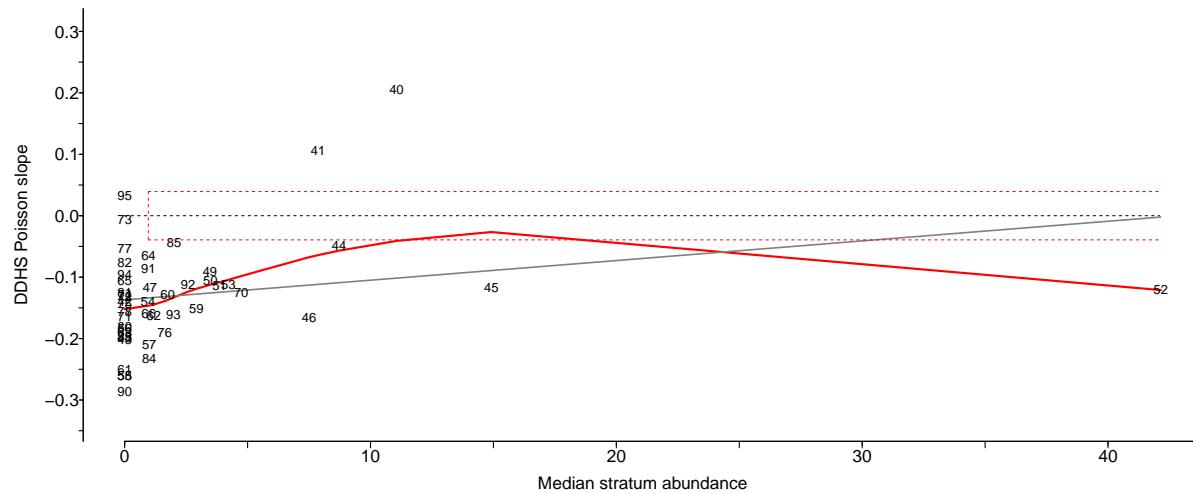


777



Freq	Depth	Temp	Sal
F5	32	1.3	31.00
F25	57	3.5	32.49
F50	77	6.1	33.30
F75	102	8.2	34.45
F95	152	10.0	35.06

Figure 7.10E. Catch distribution by depth, temperature and salinity of Witch flounder.



778

Figure 7.10F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Witch flounder.

779

## 7.11 Yellowtail flounder (Limande à queue jaune) - species code 42 (category LF)

780

Scientific name: [Limanda ferruginea](#)

781

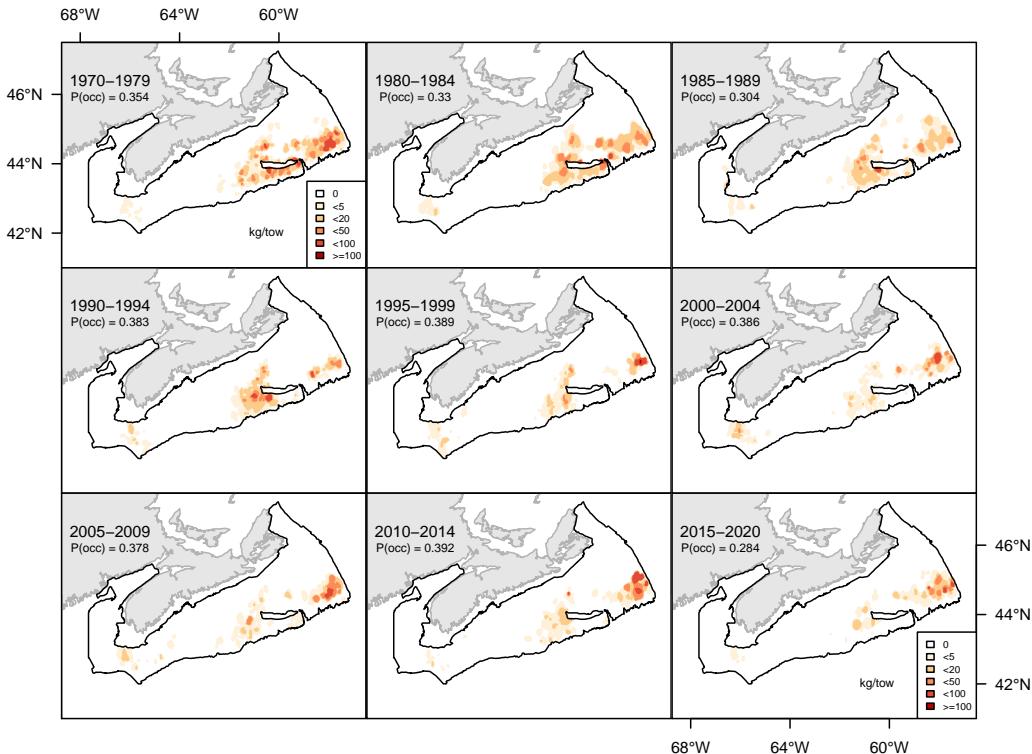


Figure 7.11A. Inverse distance weighted distribution of catch biomass (kg/tow) for Yellowtail flounder.

782

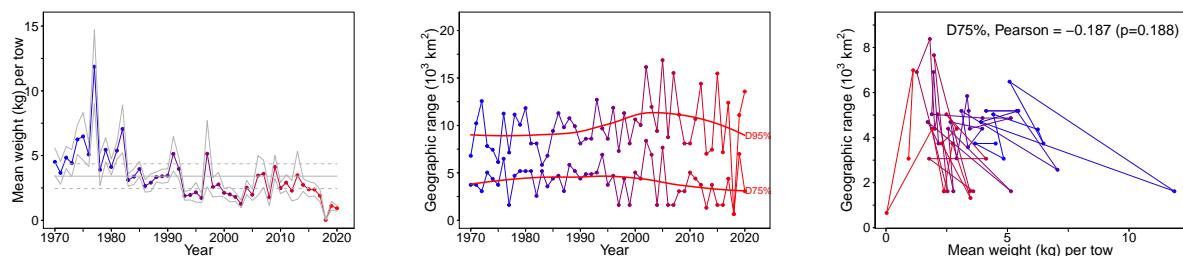


Figure 7.11B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Yellowtail flounder.

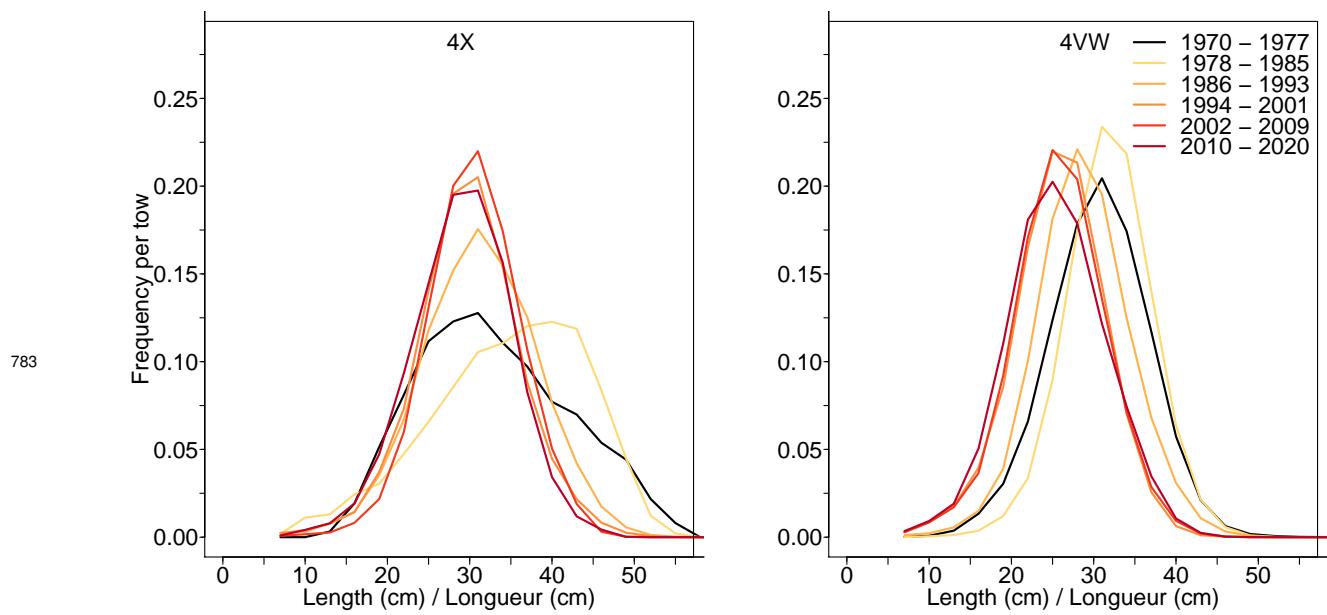


Figure 7.11C. Length frequency distribution in NAFO units 4X and 4VW for Yellowtail flounder.

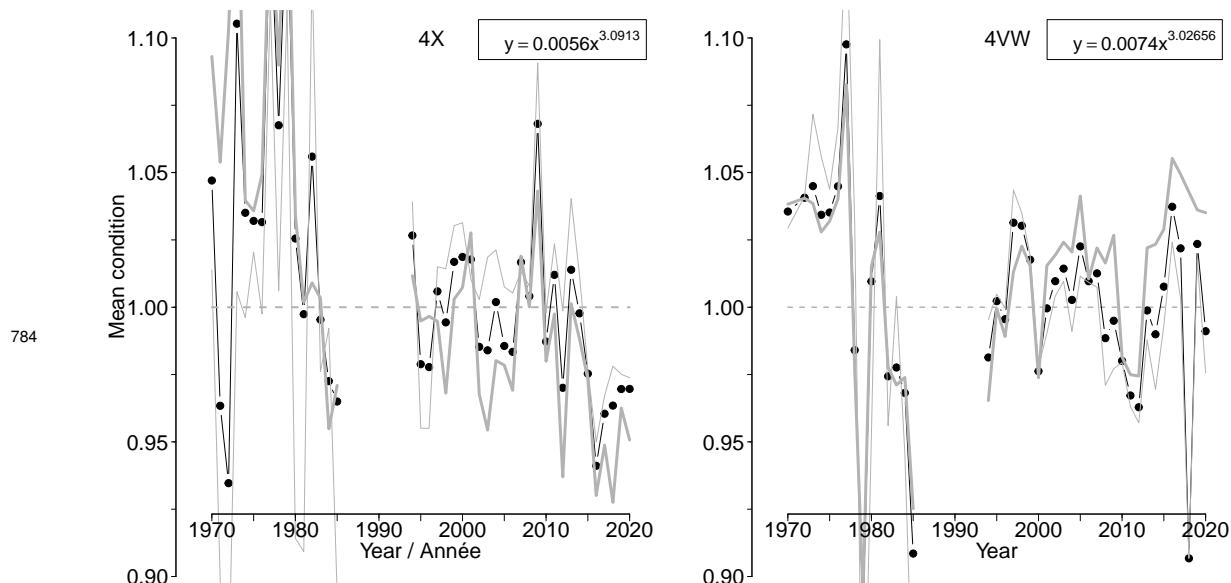
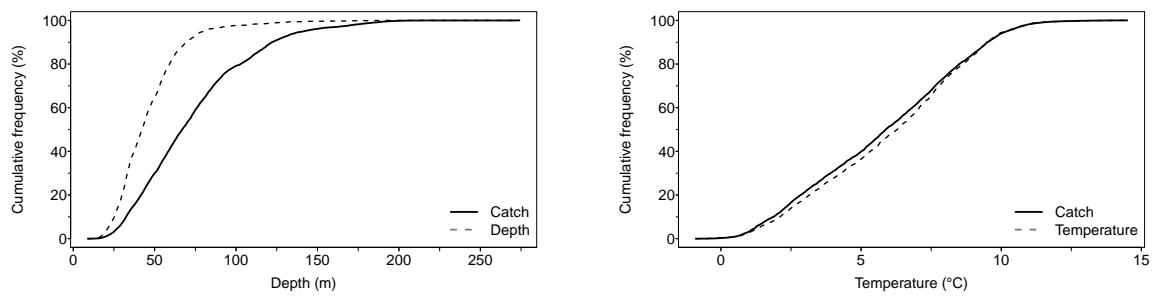
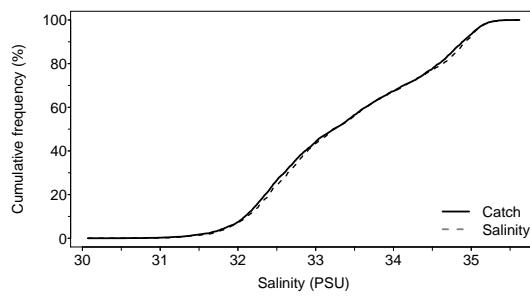


Figure 7.11D. Average fish condition in NAFO units 4X and 4VW for Yellowtail flounder.



785



Freq	Depth	Temp	Sal
F5	22	1.4	31.00
F25	32	3.7	32.52
F50	43	6.3	33.25
F75	56	8.2	34.41
F95	81	10.0	35.06

Figure 7.11E. Catch distribution by depth, temperature and salinity of Yellowtail flounder.

786

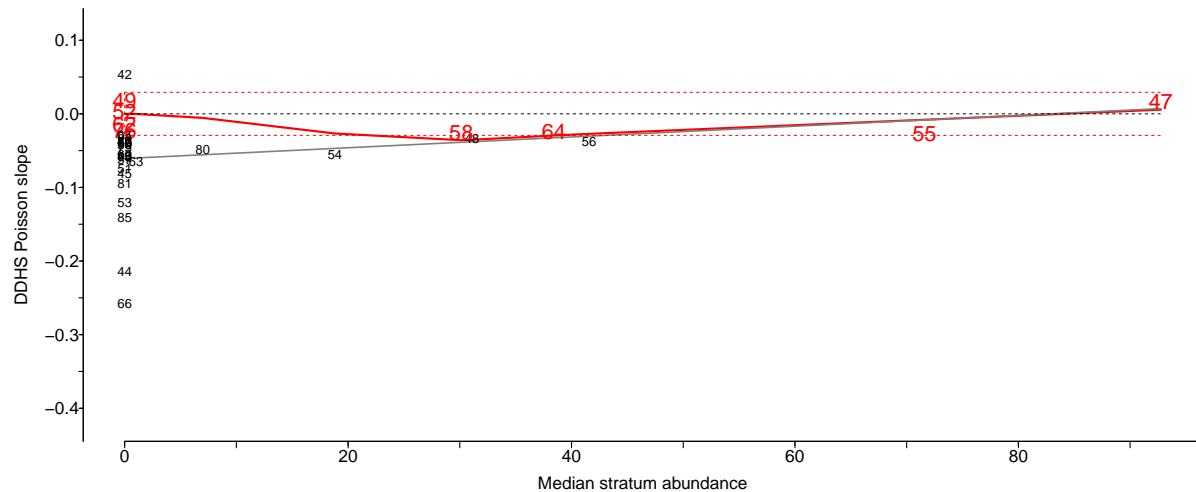


Figure 7.11F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Yellowtail flounder.

787

## 7.12 Winter flounder (Limande-plie rouge) - species code 43 (category LF)

788

Scientific name: [Pseudopleuronectes americanus](#)

789

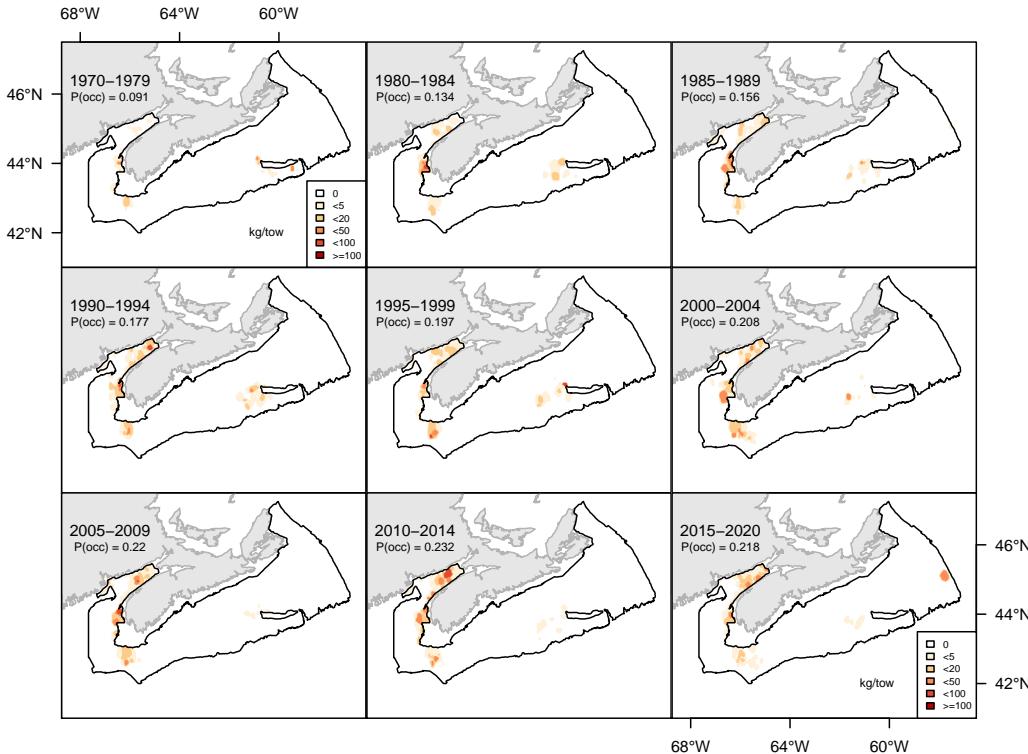


Figure 7.12A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter flounder.

790

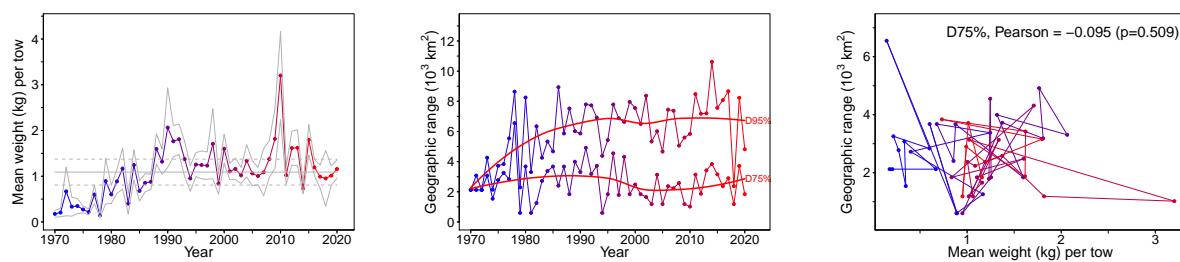


Figure 7.12B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter flounder.

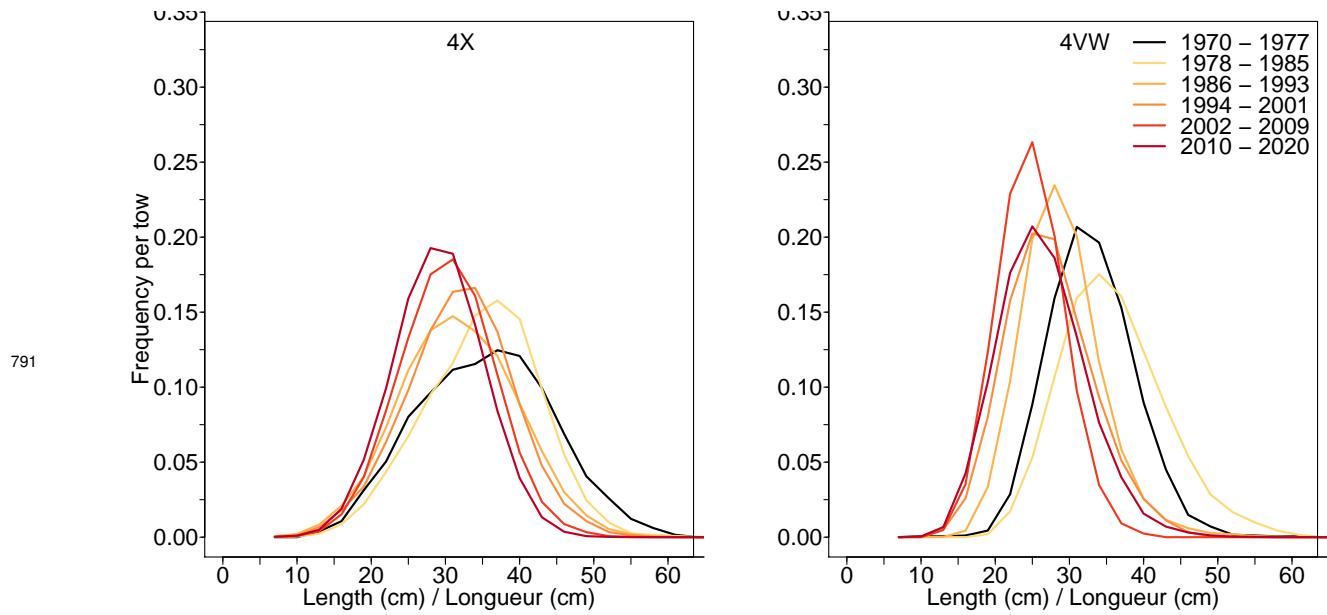


Figure 7.12C. Length frequency distribution in NAFO units 4X and 4VW for Winter flounder.

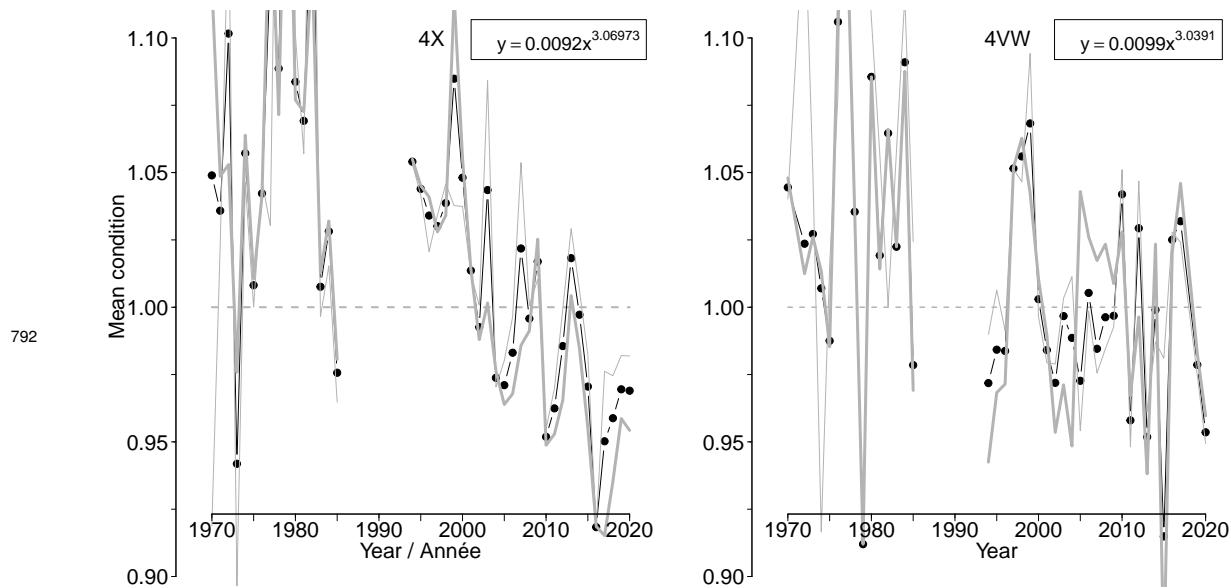
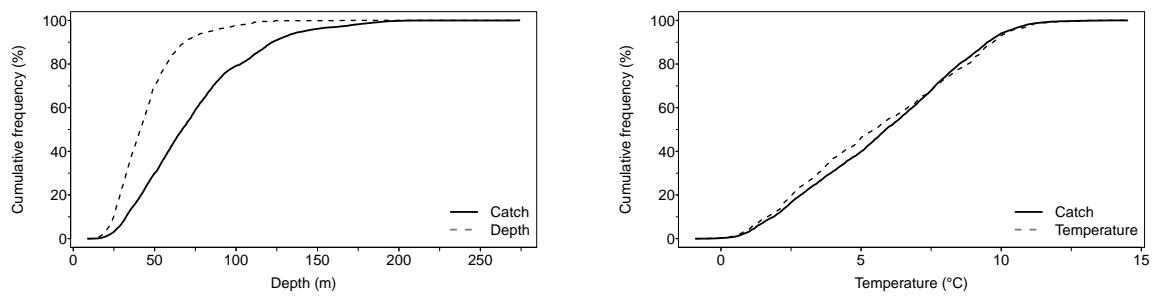
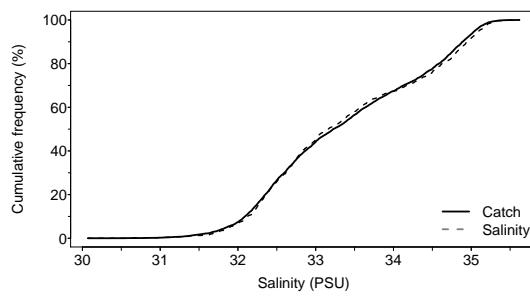


Figure 7.12D. Average fish condition in NAFO units 4X and 4VW for Winter flounder.



793



Freq	Depth	Temp	Sal
F5	22	1.1	31.00
F25	31	3.0	32.48
F50	42	5.5	33.17
F75	54	8.3	34.47
F95	84	10.0	35.10

Figure 7.12E. Catch distribution by depth, temperature and salinity of Winter flounder.

794

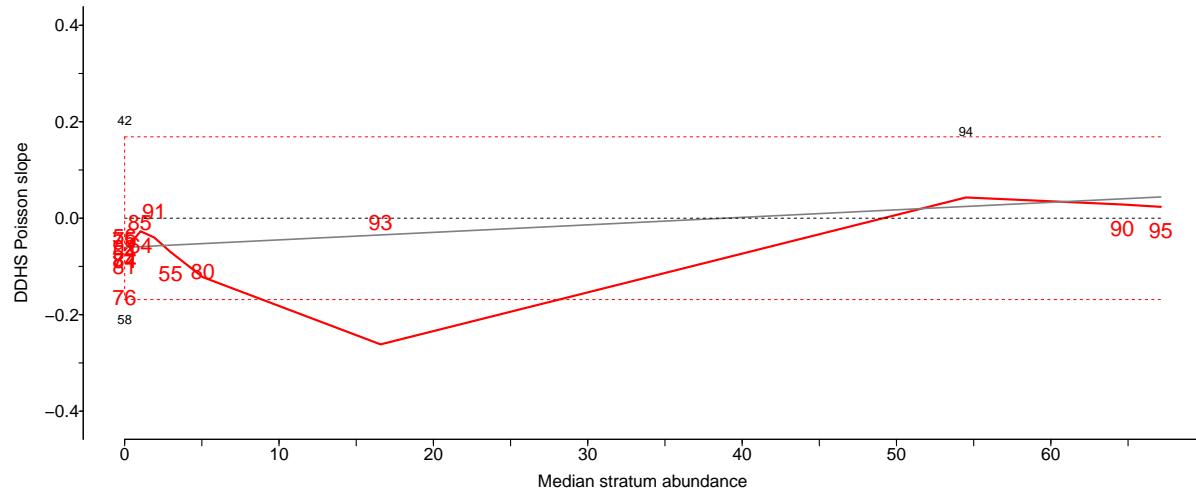


Figure 7.12F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter flounder.

795

## 7.13 Atlantic wolffish (Loup atlantique) - species code 50 (category LF)

796

Scientific name: [Anarhichas lupus](#)

797

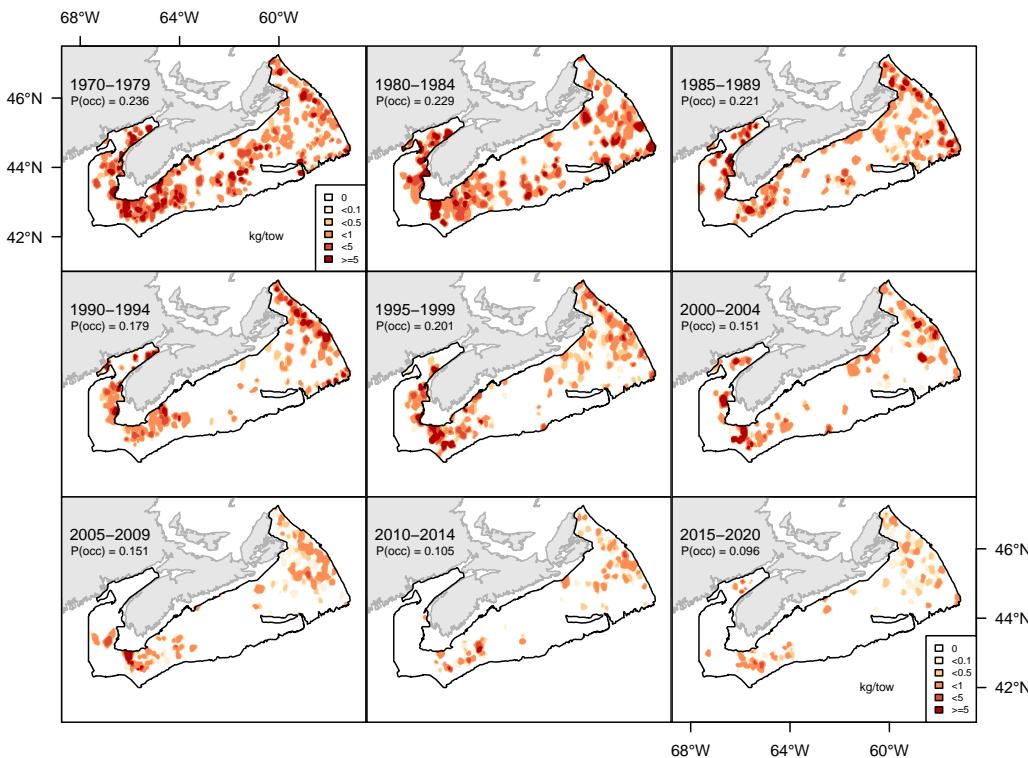


Figure 7.13A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic wolffish.

798

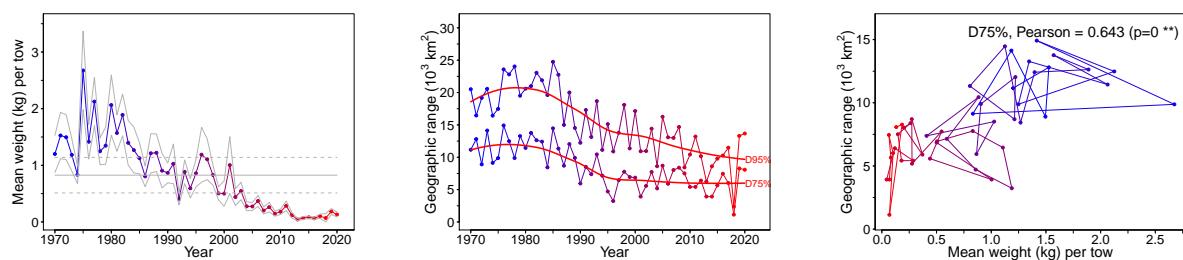


Figure 7.13B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic wolffish.

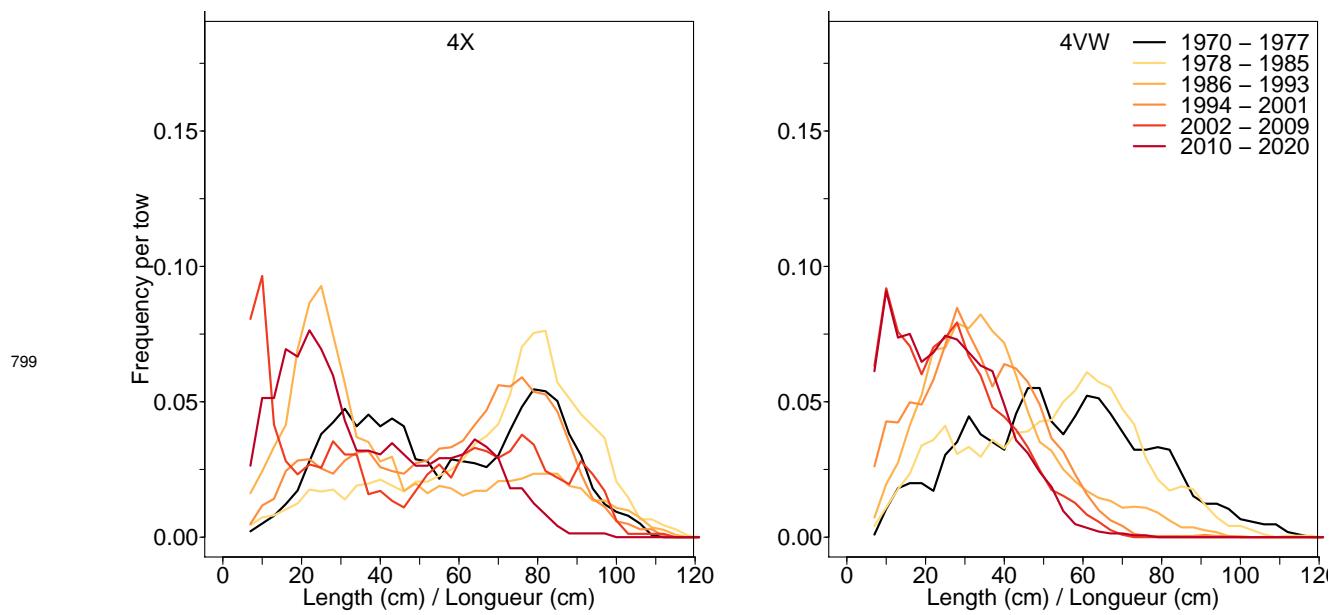


Figure 7.13C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic wolffish.

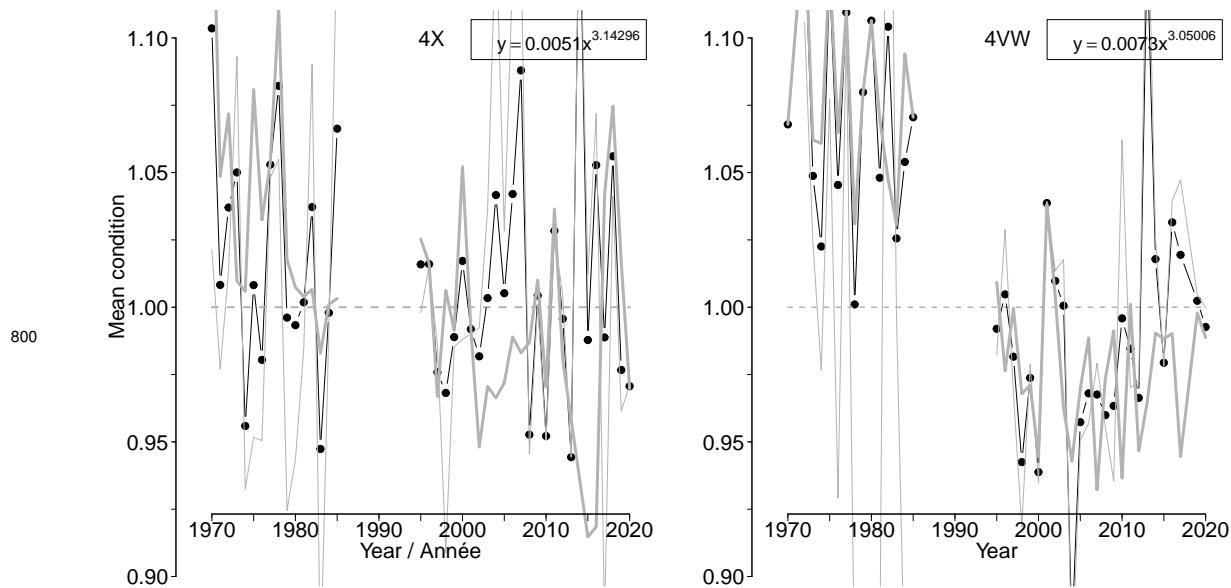
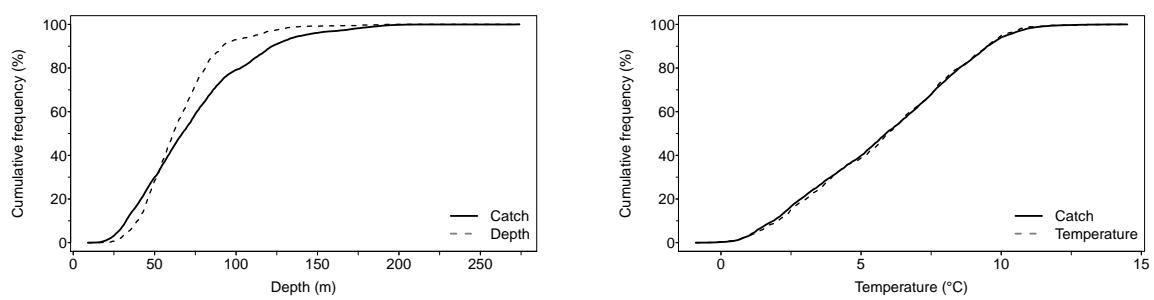


Figure 7.13D. Average fish condition in NAFO units 4X and 4VW for Atlantic wolffish.



Freq	Depth	Temp	Sal
F5	34	1.4	31.00
F25	49	3.6	32.48
F50	62	6.0	33.25
F75	77	8.1	34.33
F95	112	10.0	35.05

Figure 7.13E. Catch distribution by depth, temperature and salinity of Atlantic wolffish.

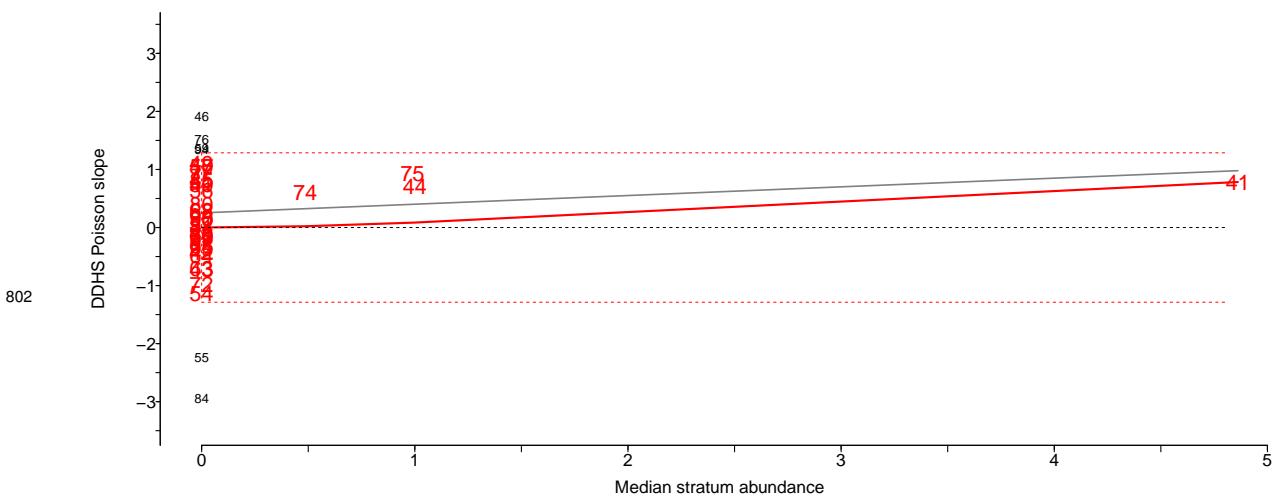


Figure 7.13F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic wolffish.

803      **7.14 Atlantic herring (Hareng de l'Atlantique) - species code 60 (category LF)**

804      Scientific name: [Clupea harengus](#)

805

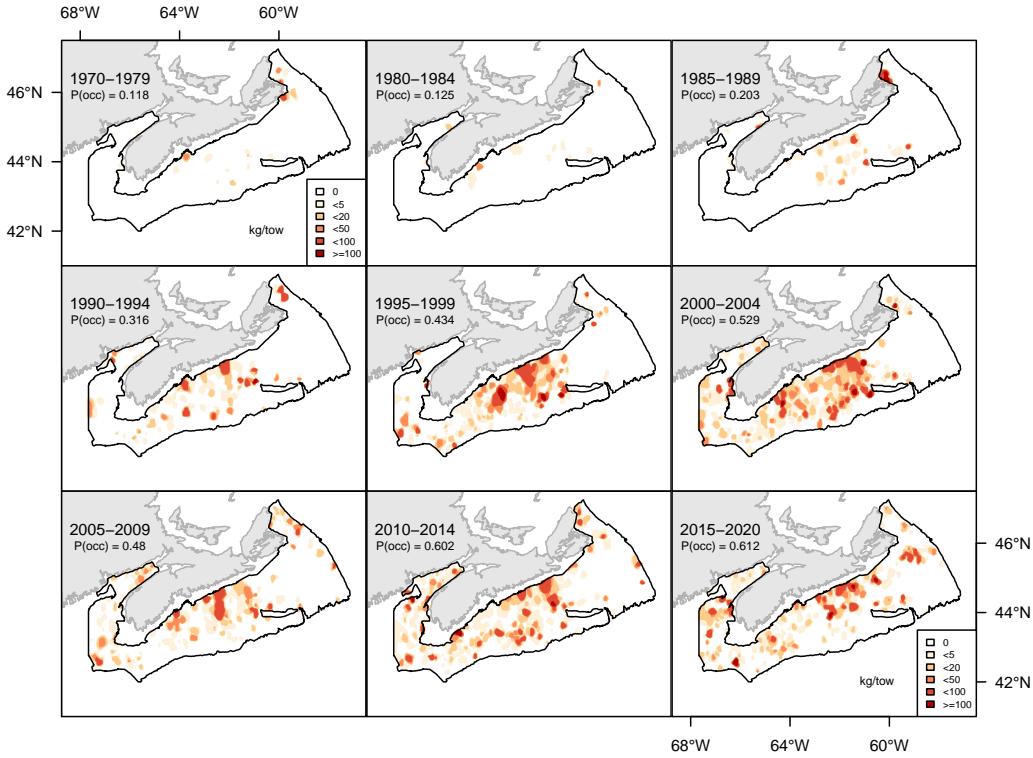


Figure 7.14A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic herring.

806

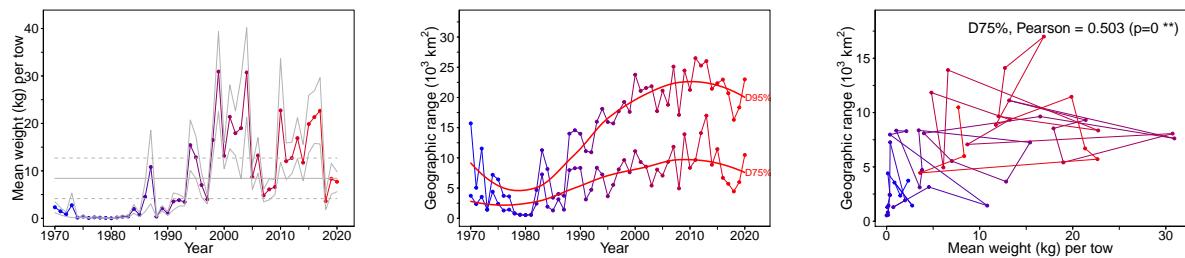


Figure 7.14B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic herring.

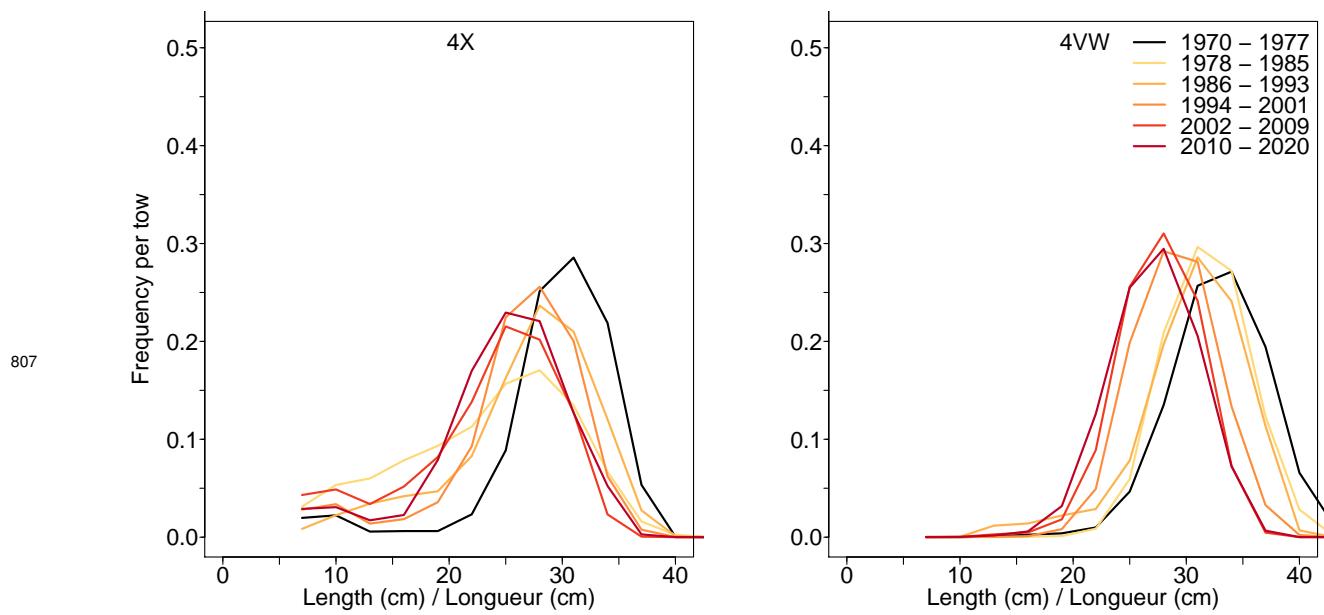


Figure 7.14C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic herring.

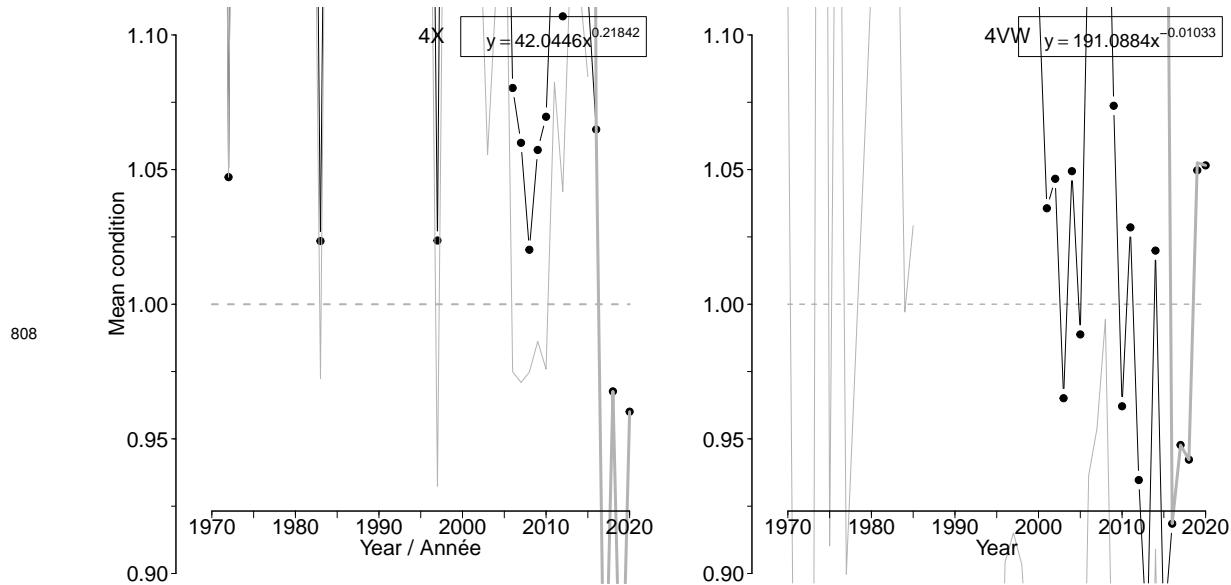
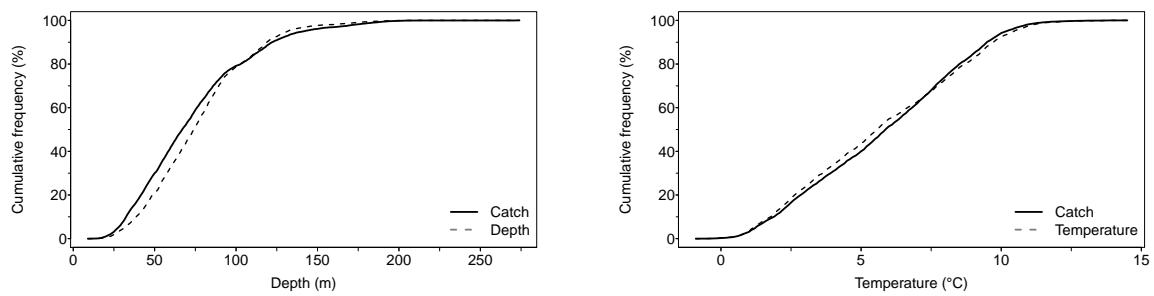
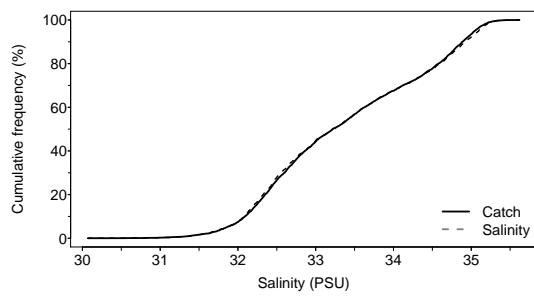


Figure 7.14D. Average fish condition in NAFO units 4X and 4VW for Atlantic herring.



809



Freq	Depth	Temp	Sal
F5	32	1.2	31.00
F25	54	3.2	32.45
F50	74	5.6	33.22
F75	95	8.3	34.38
F95	132	10.0	35.10

Figure 7.14E. Catch distribution by depth, temperature and salinity of Atlantic herring.

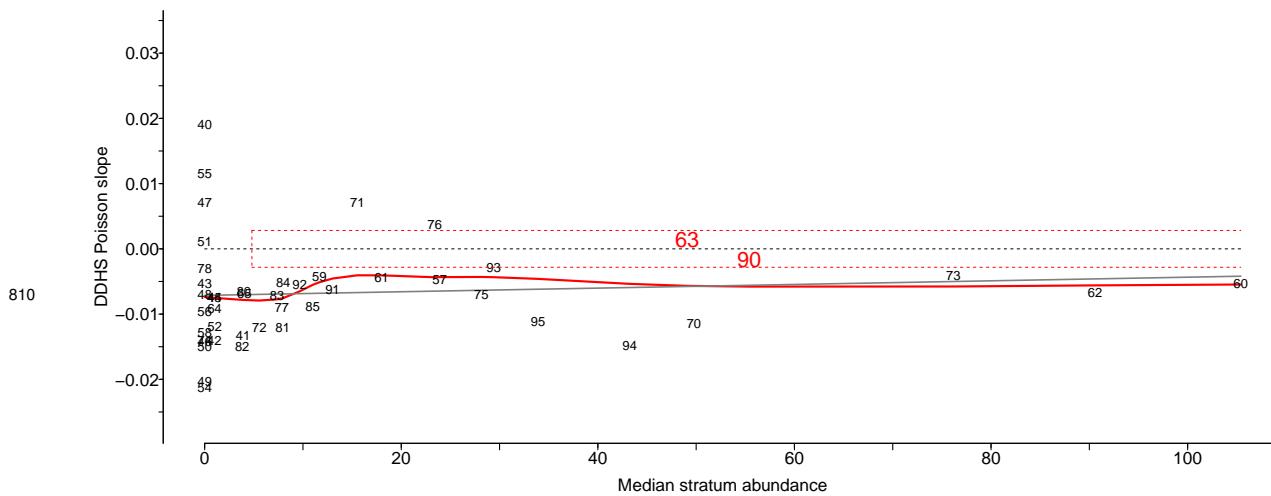


Figure 7.14F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic herring.

811      **7.15 Longhorn sculpin (Chabotisseau à dix-huit épines) - species code 300 (category**  
 812      **LF)**

813      Scientific name: [Myoxocephalus octodecemspiniferus](#)

814

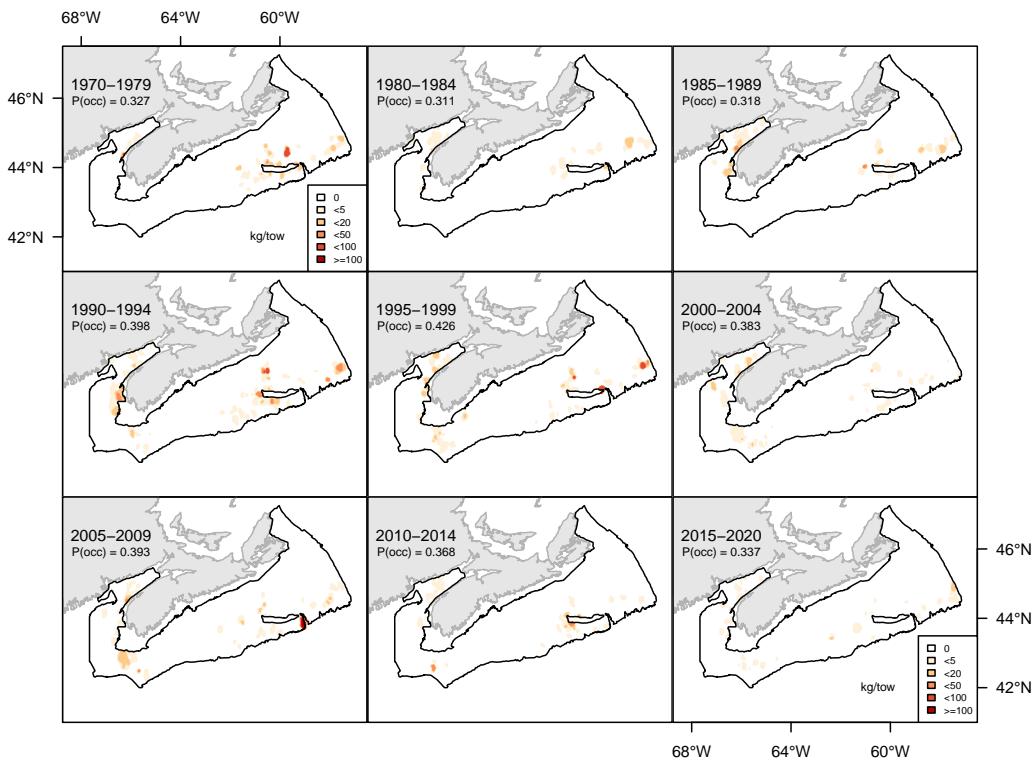


Figure 7.15A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longhorn sculpin.

815

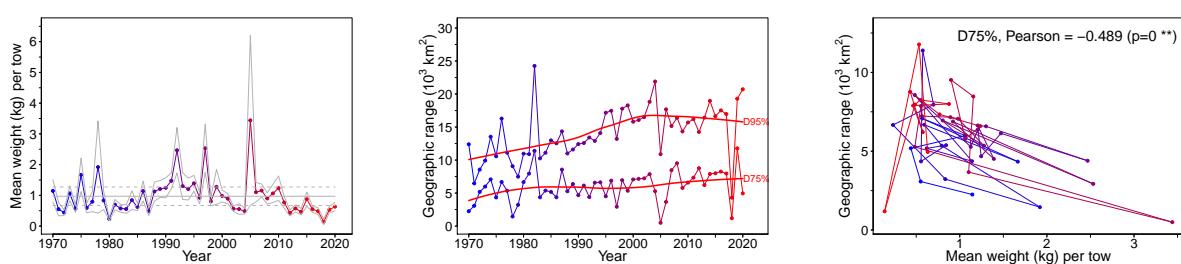


Figure 7.15B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longhorn sculpin.

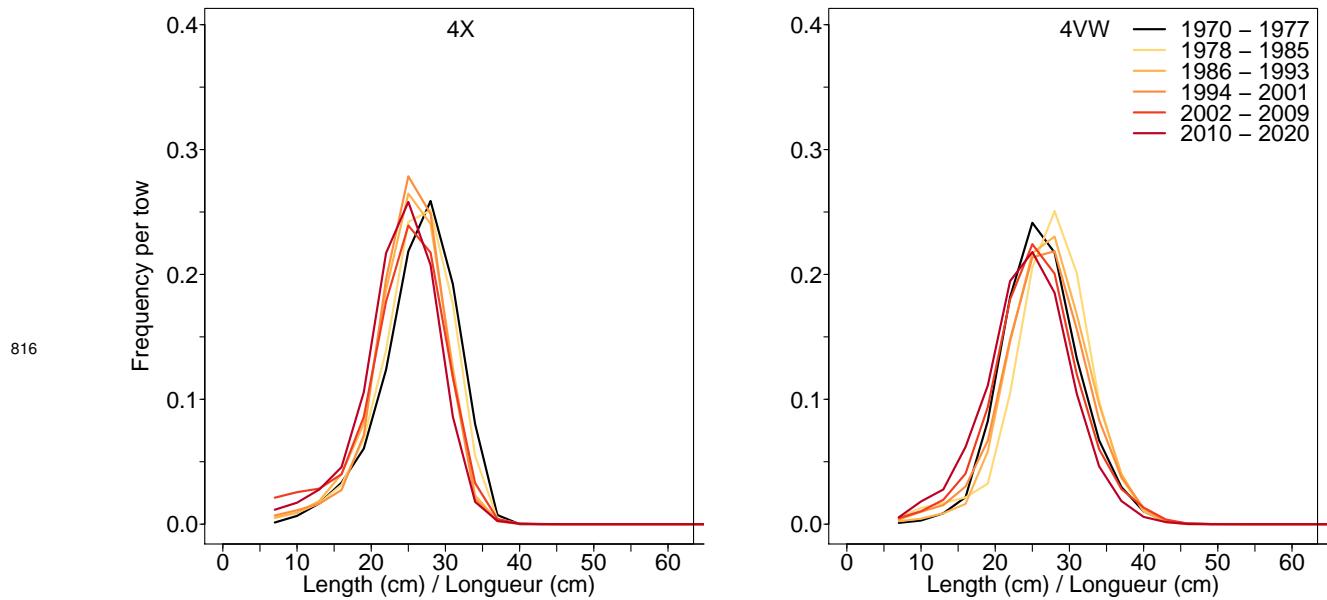


Figure 7.15C. Length frequency distribution in NAFO units 4X and 4VW for Longhorn sculpin.

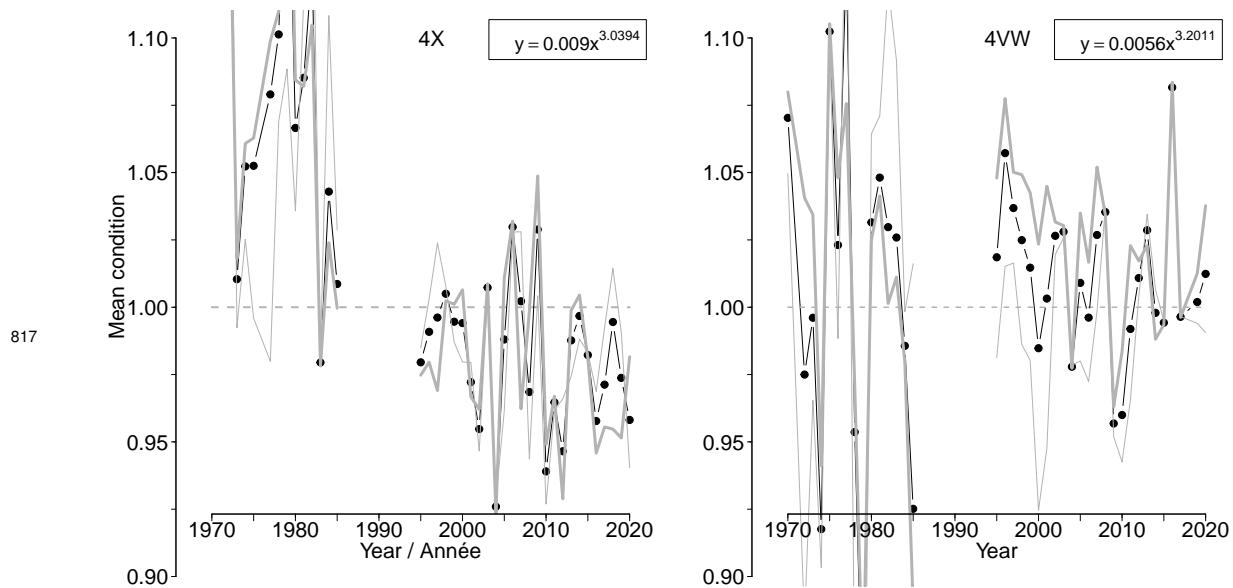
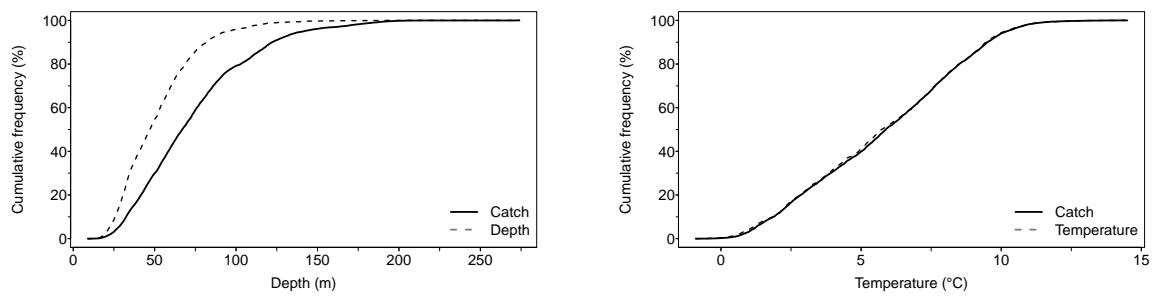
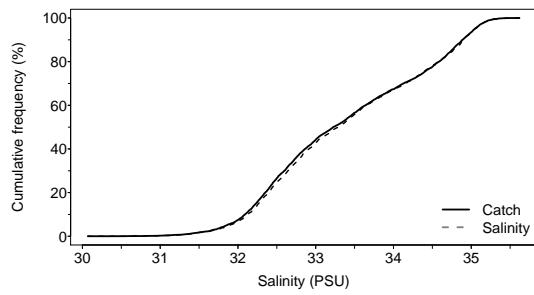


Figure 7.15D. Average fish condition in NAFO units 4X and 4VW for Longhorn sculpin.



818



Freq	Depth	Temp	Sal
F5	23	1.2	31.00
F25	33	3.3	32.51
F50	48	5.8	33.29
F75	64	8.1	34.38
F95	96	10.0	35.05

Figure 7.15E. Catch distribution by depth, temperature and salinity of Longhorn sculpin.

819

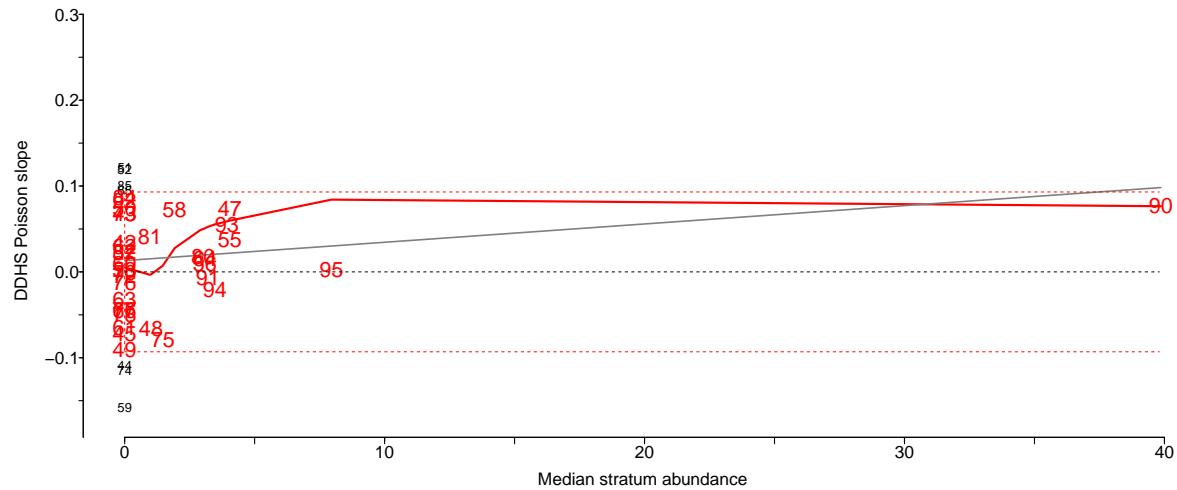


Figure 7.15F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Longhorn sculpin.

820

## 7.16 Moustache sculpin (Faux-trigle armé) - species code 304 (category LF)

821

Scientific name: [Triglops murrayi](#)

822

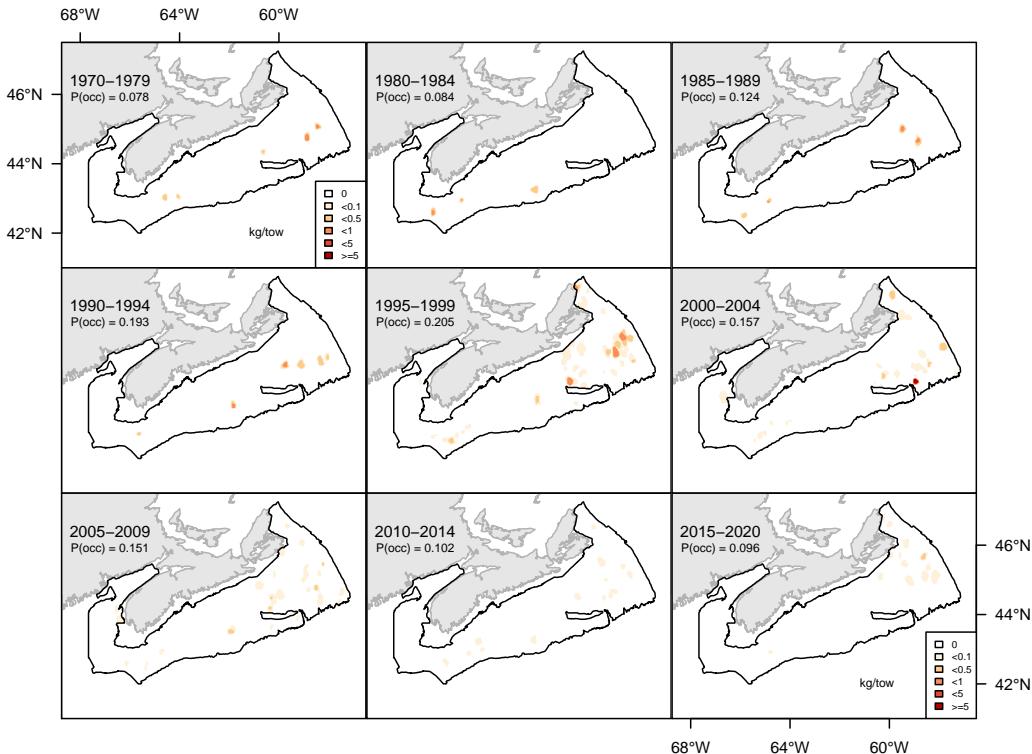


Figure 7.16A. Inverse distance weighted distribution of catch biomass (kg/tow) for Moustache sculpin.

823

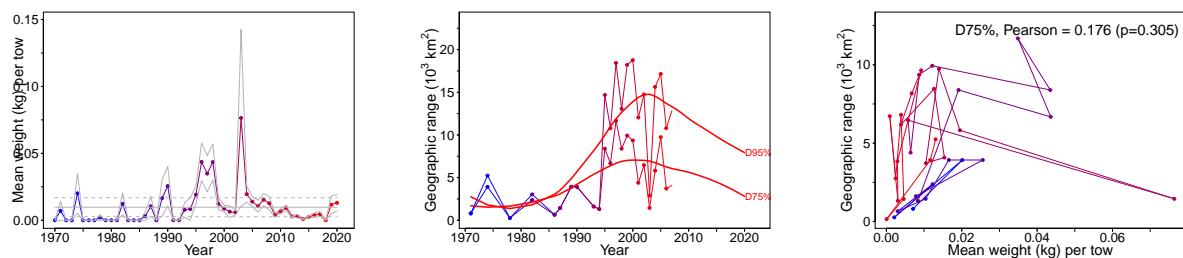


Figure 7.16B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Moustache sculpin.

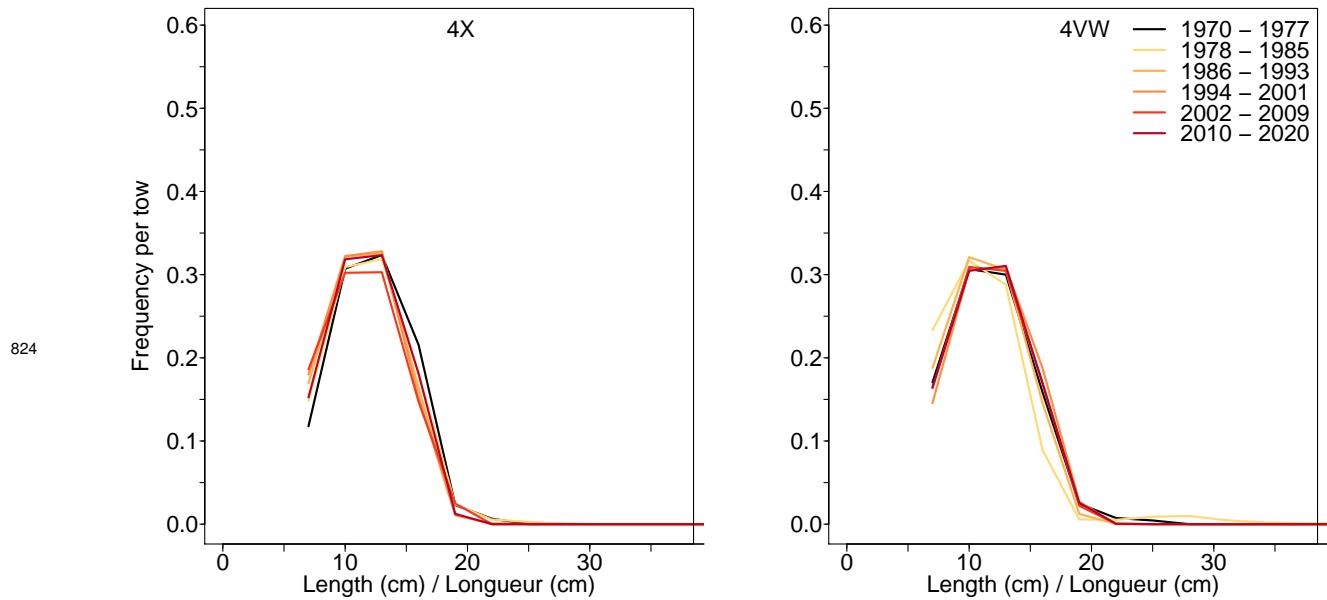


Figure 7.16C. Length frequency distribution in NAFO units 4X and 4VW for Moustache sculpin.

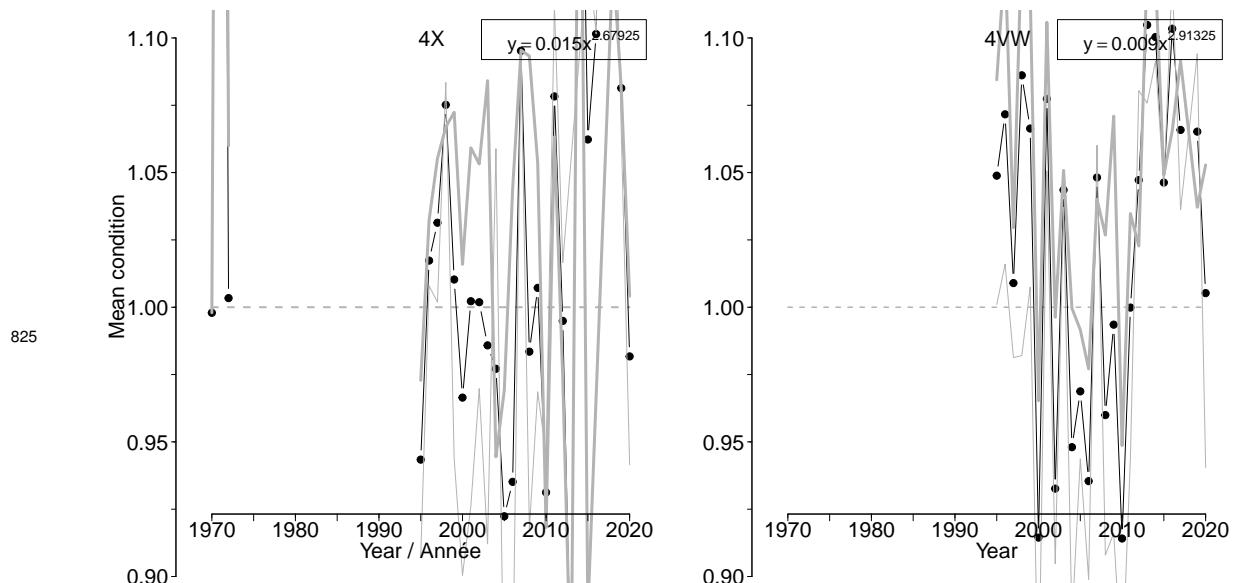
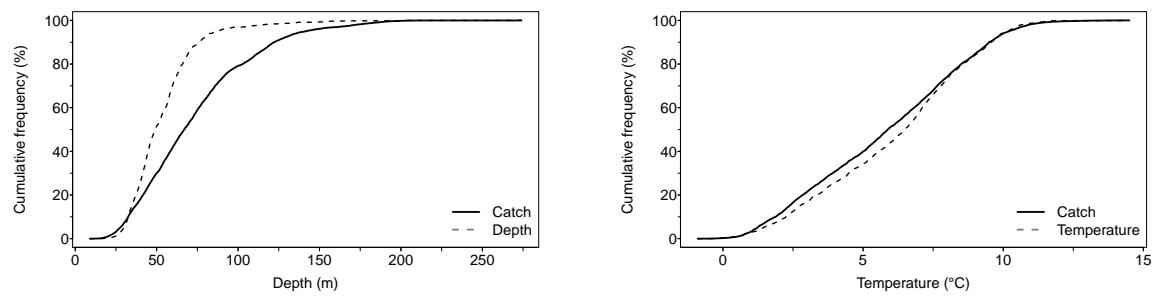
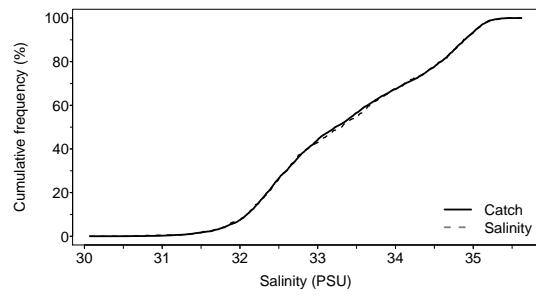


Figure 7.16D. Average fish condition in NAFO units 4X and 4VW for Moustache sculpin.



826



Freq	Depth	Temp	Sal
F5	30	1.5	31.00
F25	40	4.0	32.48
F50	50	6.5	33.31
F75	63	8.2	34.39
F95	88	10.0	35.06

Figure 7.16E. Catch distribution by depth, temperature and salinity of Moustache sculpin.

827

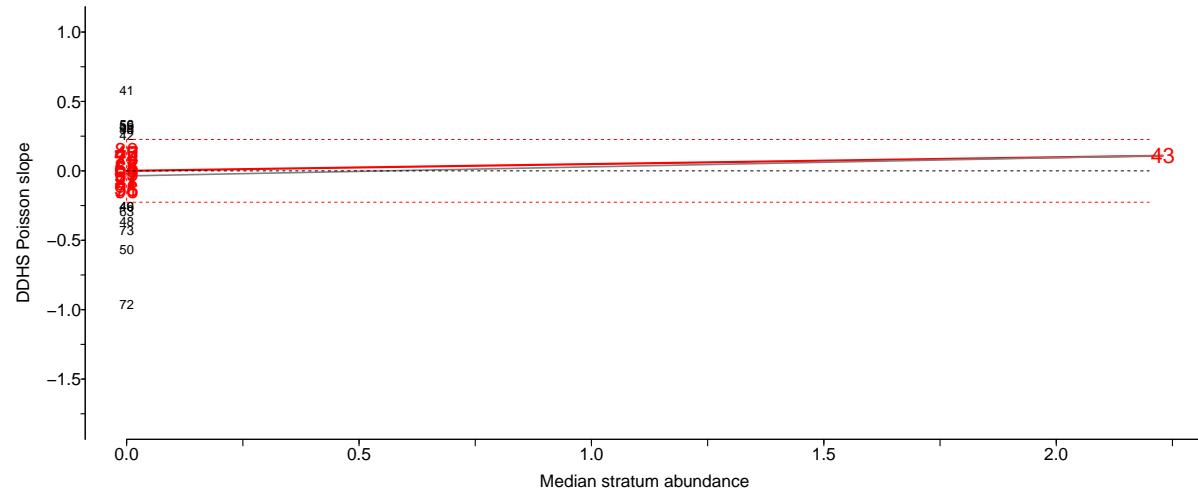


Figure 7.16F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Moustache sculpin.

828

## 7.17 Sea raven (Hémithriptère atlantique) - species code 320 (category LF)

829

Scientific name: [Hemitripterus americanus](#)

830

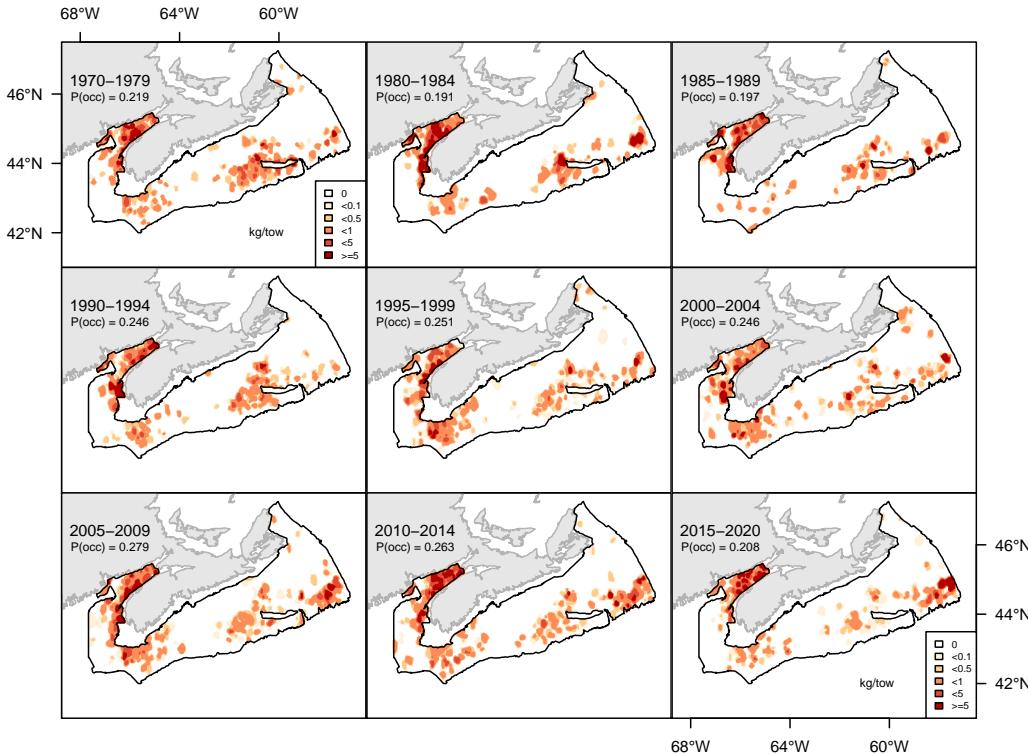


Figure 7.17A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sea raven.

831

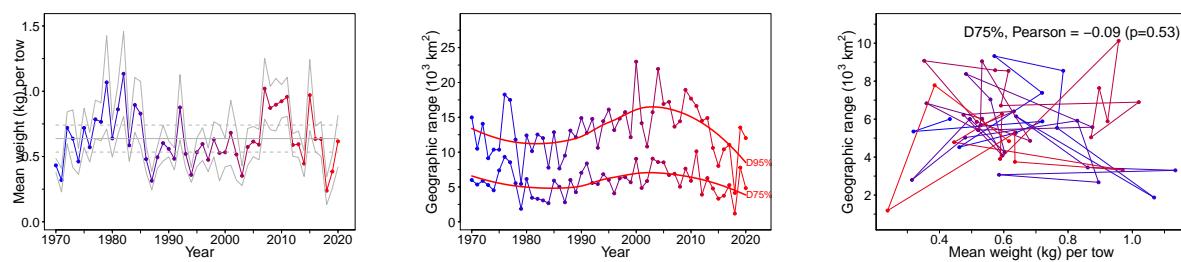


Figure 7.17B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sea raven.

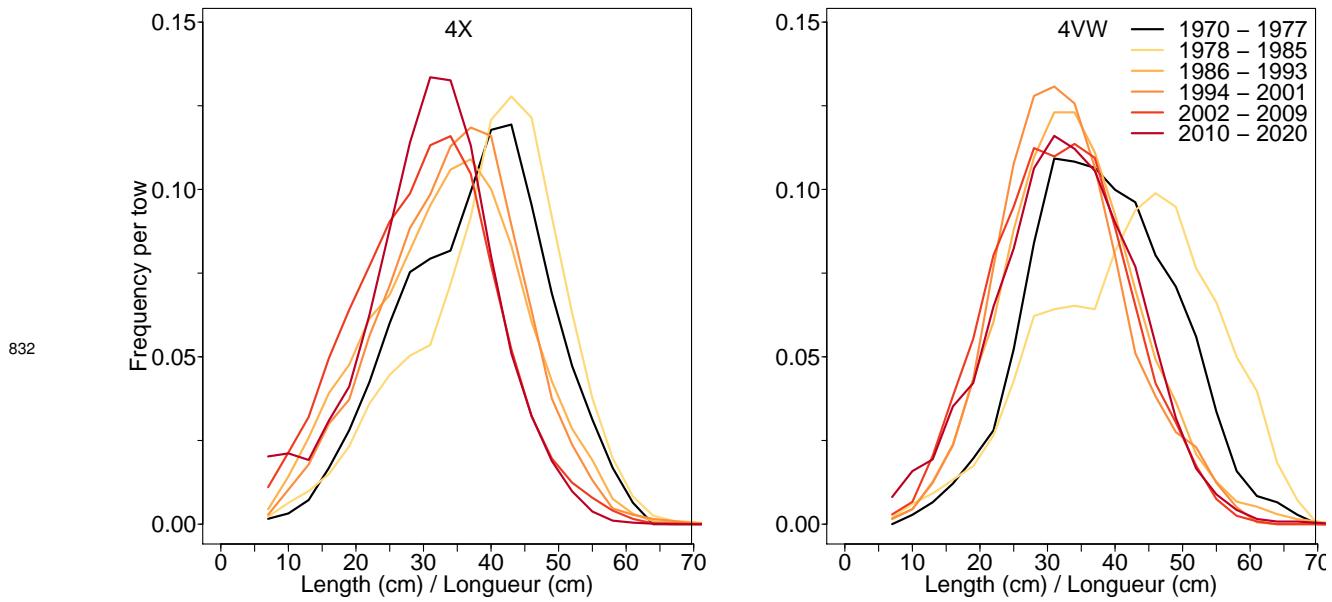


Figure 7.17C. Length frequency distribution in NAFO units 4X and 4VW for Sea raven.

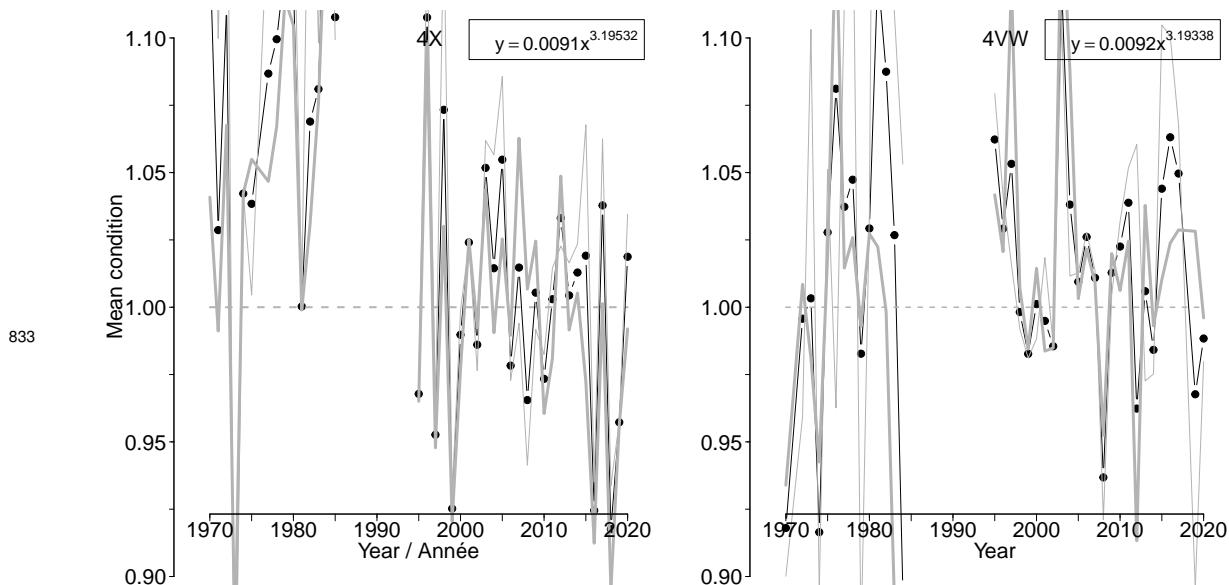
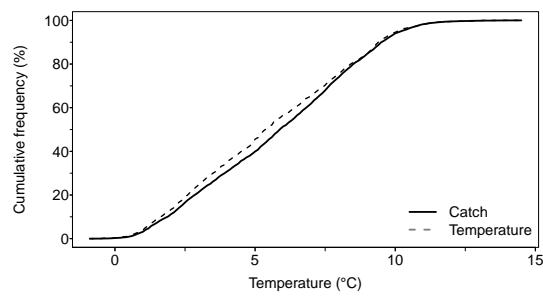
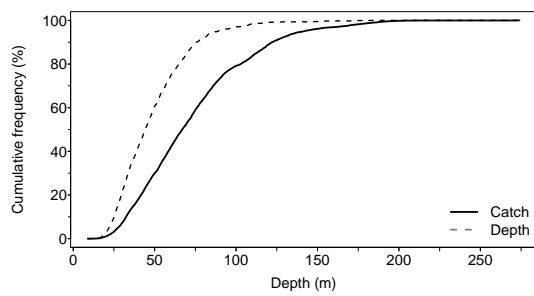
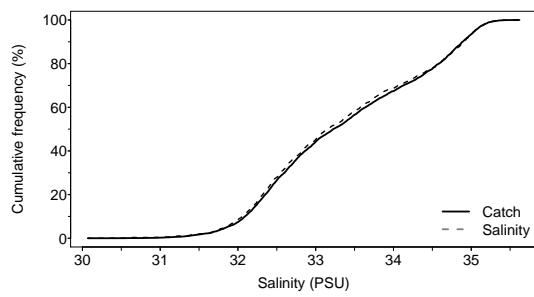


Figure 7.17D. Average fish condition in NAFO units 4X and 4VW for Sea raven.

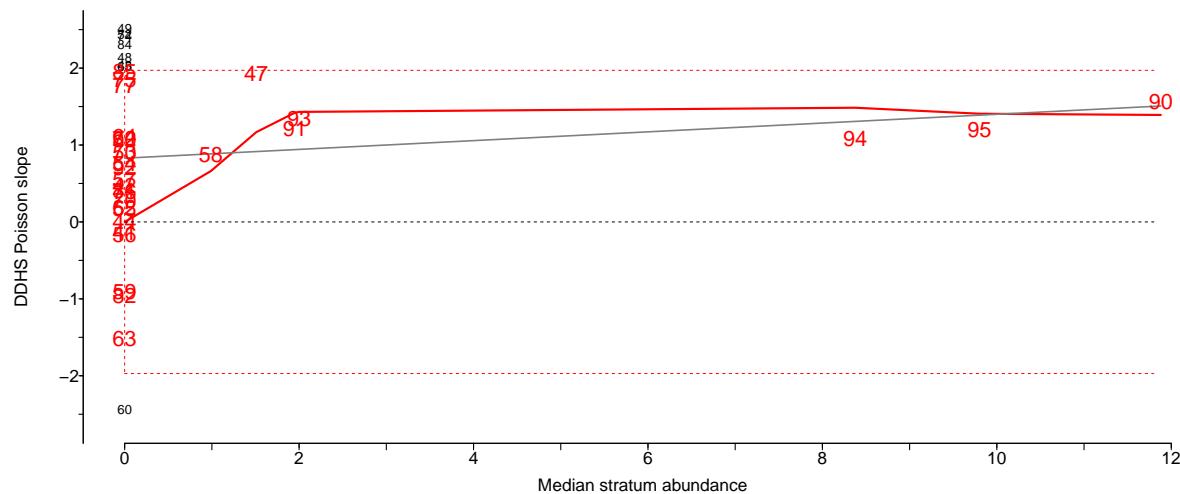


834



Freq	Depth	Temp	Sal
F5	22	1.1	31.00
F25	32	3.1	32.43
F50	45	5.4	33.15
F75	61	8.0	34.35
F95	89	10.0	35.05

Figure 7.17E. Catch distribution by depth, temperature and salinity of Sea raven.



835

Figure 7.17F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Sea raven.

836      **7.18 Alligatorfish (Poisson-alligator atlantique) - species code 340 (category LF)**

837      Scientific name: [Aspidophoroides monopterygius](#)

838

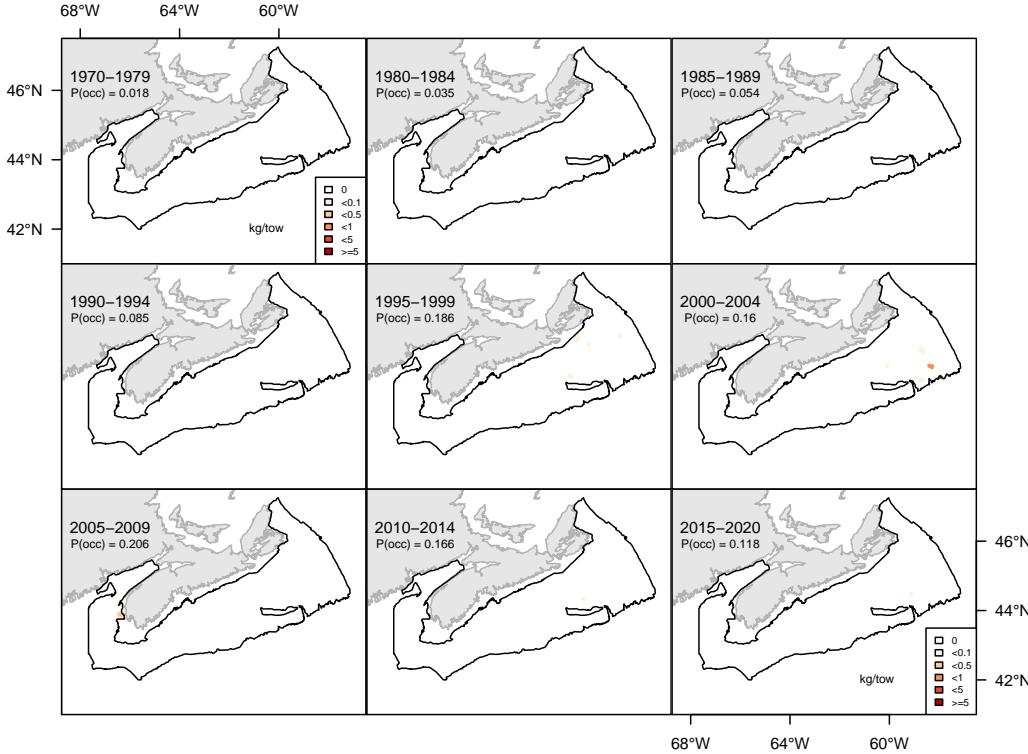


Figure 7.18A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alligatorfish.

839

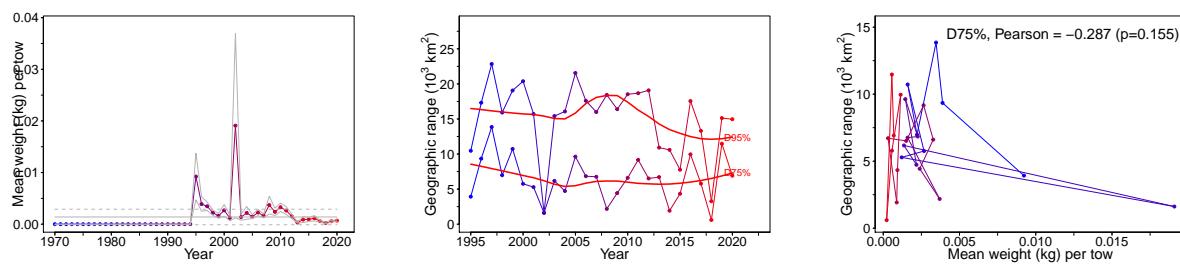


Figure 7.18B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alligatorfish.

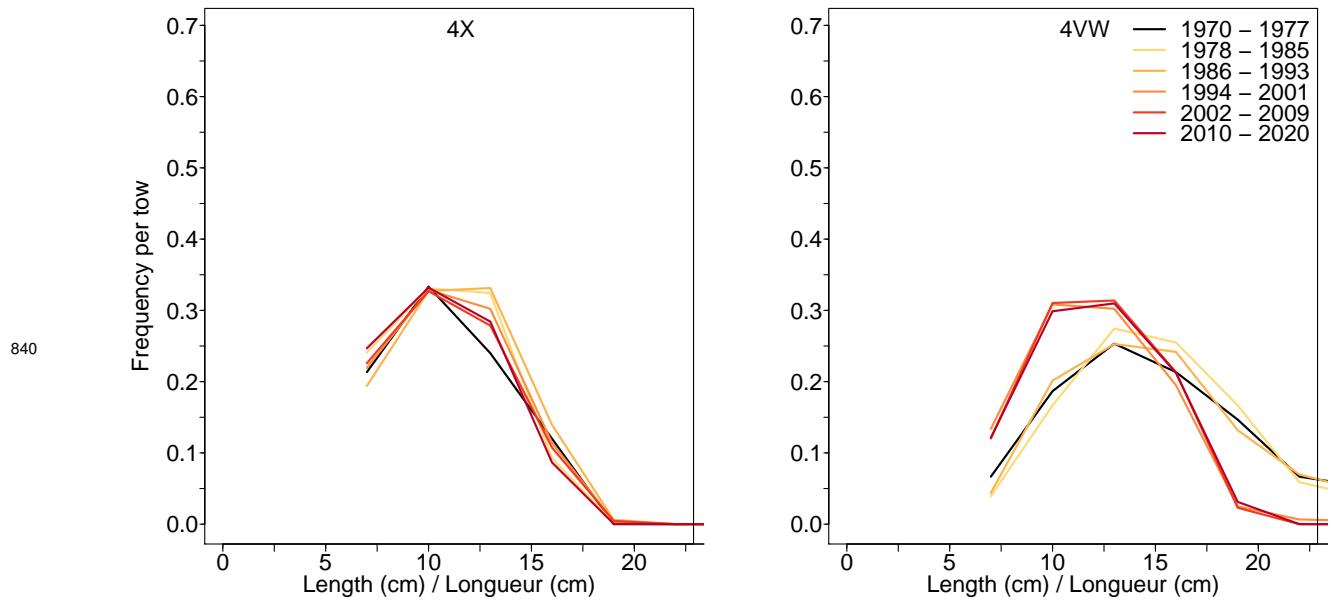


Figure 7.18C. Length frequency distribution in NAFO units 4X and 4VW for Alligatorfish.

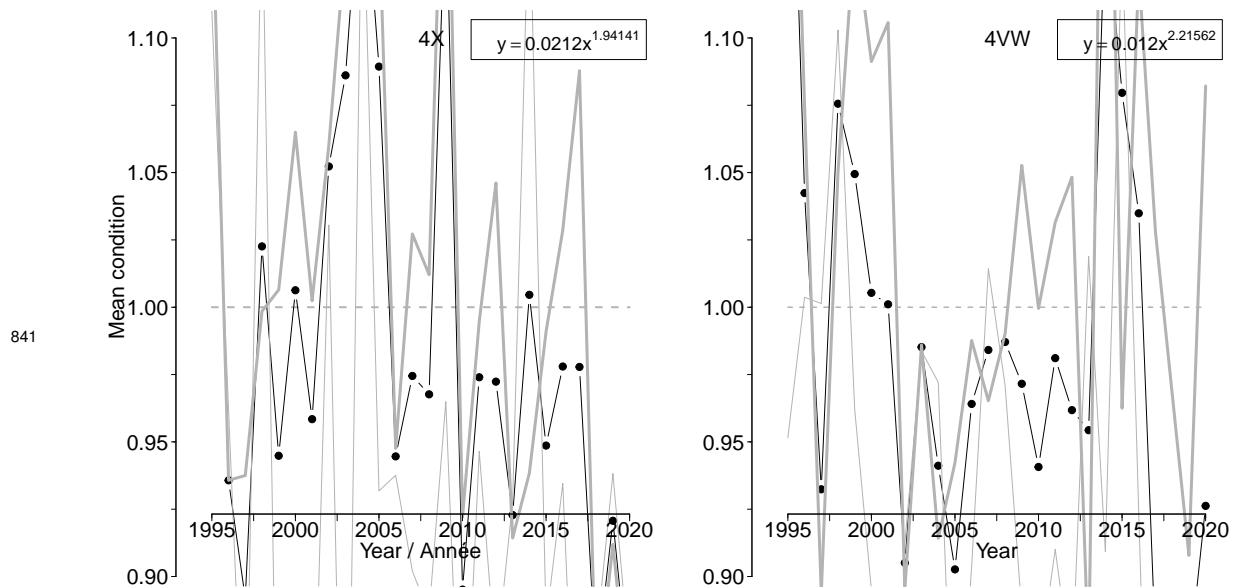
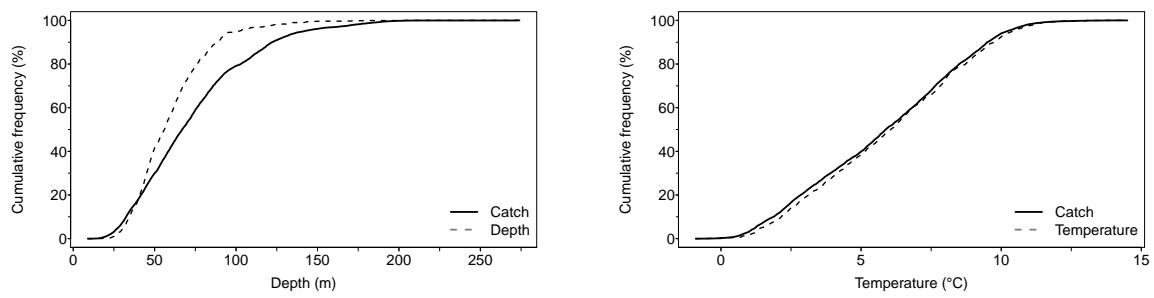
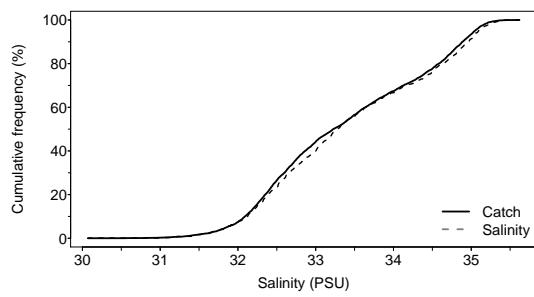


Figure 7.18D. Average fish condition in NAFO units 4X and 4VW for Alligatorfish.



842



Freq	Depth	Temp	Sal
F5	32	1.5	31.00
F25	44	3.7	32.53
F50	57	6.1	33.28
F75	72	8.2	34.45
F95	102	10.0	35.10

Figure 7.18E. Catch distribution by depth, temperature and salinity of Alligatorfish.

843

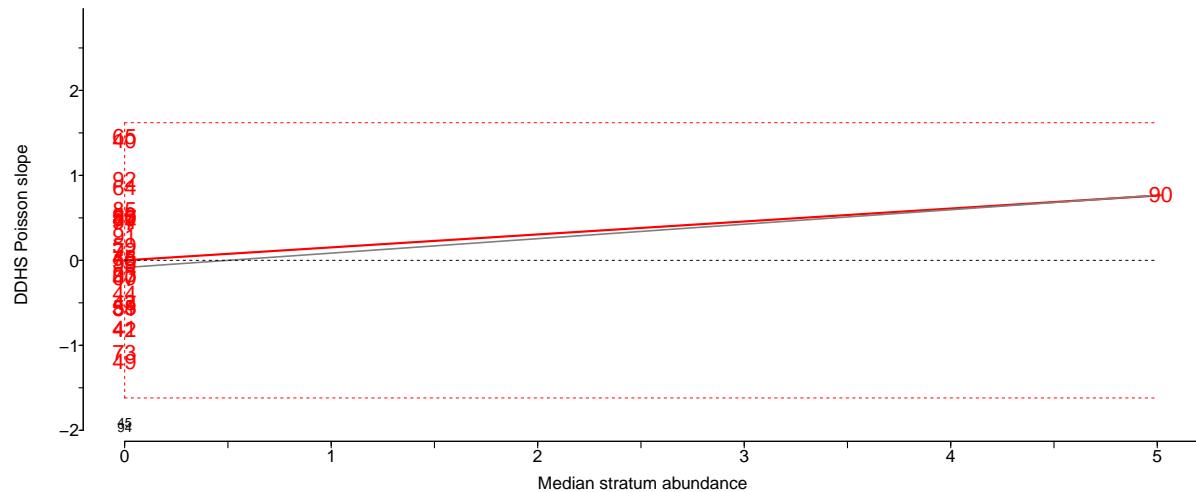


Figure 7.18F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Alligatorfish.

844

## 7.19 Monkfish (Baudroie d'Amérique) - species code 400 (category LF)

845

Scientific name: [Lophius americanus](#)

846

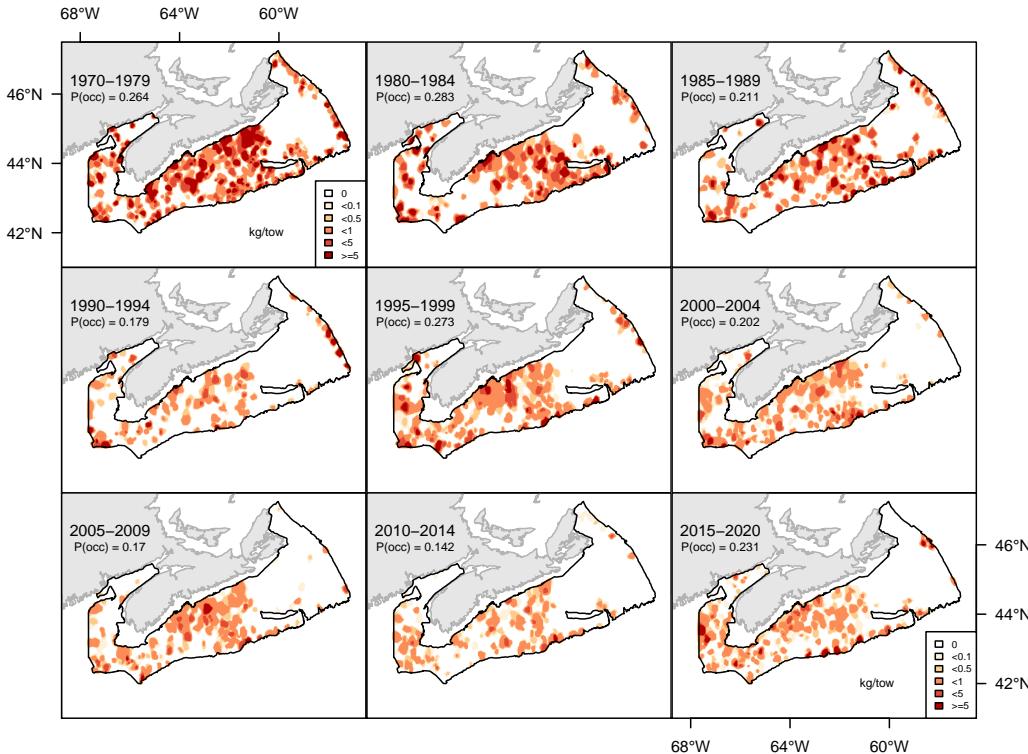


Figure 7.19A. Inverse distance weighted distribution of catch biomass (kg/tow) for Monkfish.

847

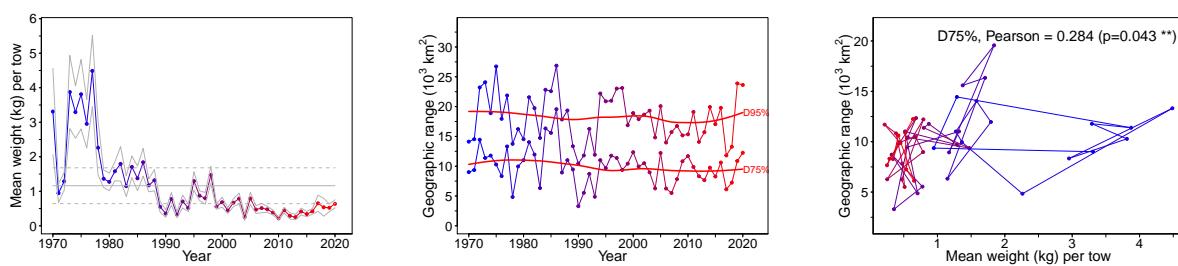


Figure 7.19B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Monkfish.

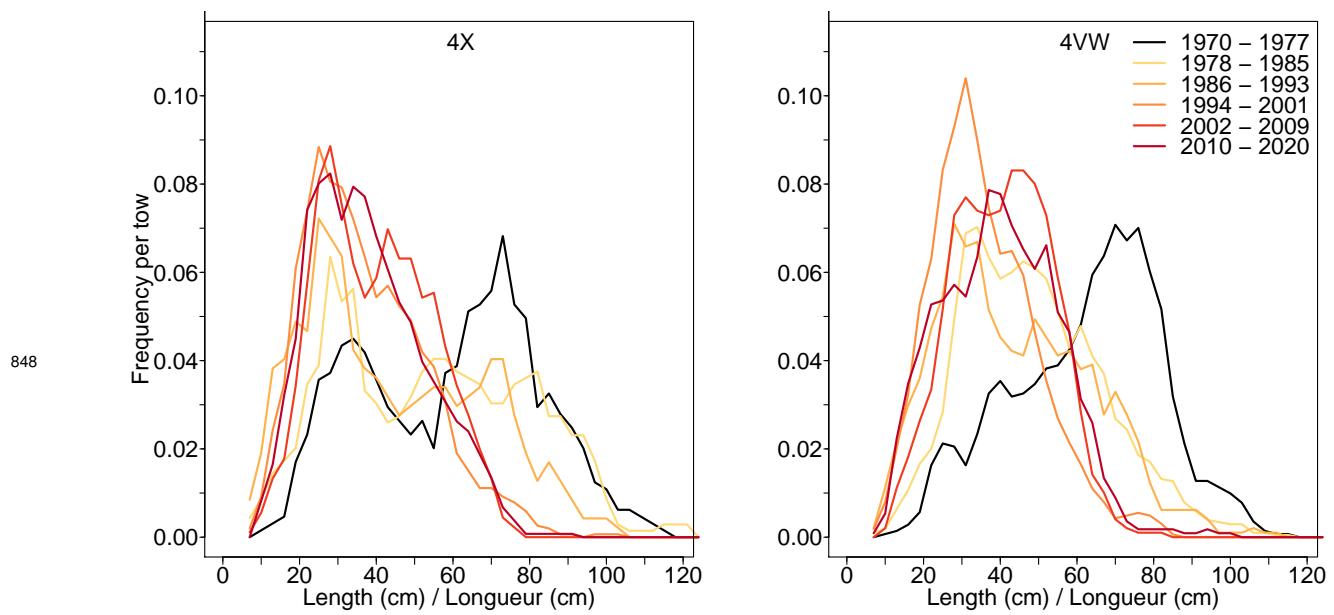


Figure 7.19C. Length frequency distribution in NAFO units 4X and 4VW for Monkfish.

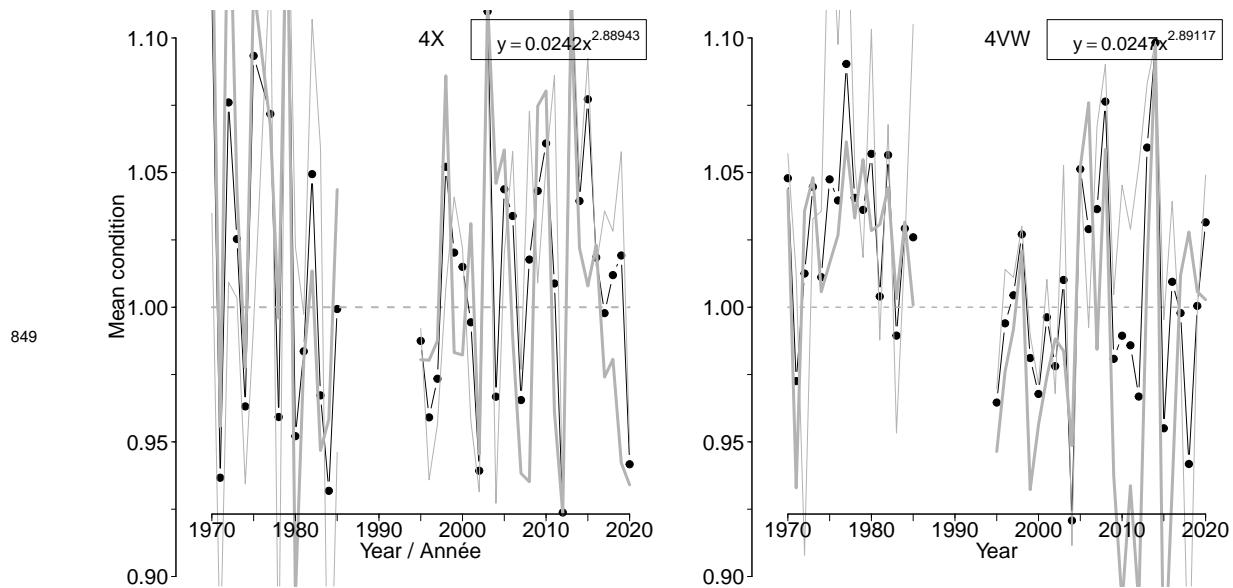
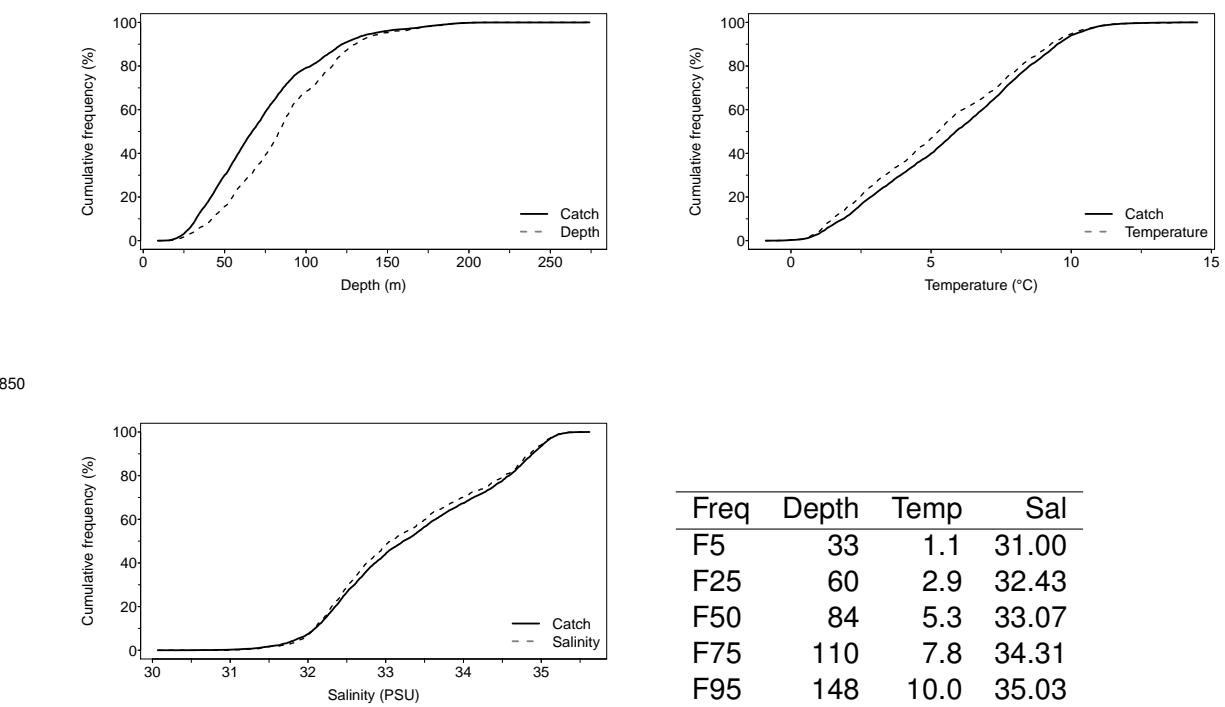


Figure 7.19D. Average fish condition in NAFO units 4X and 4VW for Monkfish.



Freq	Depth	Temp	Sal
F5	33	1.1	31.00
F25	60	2.9	32.43
F50	84	5.3	33.07
F75	110	7.8	34.31
F95	148	10.0	35.03

Figure 7.19E. Catch distribution by depth, temperature and salinity of Monkfish.

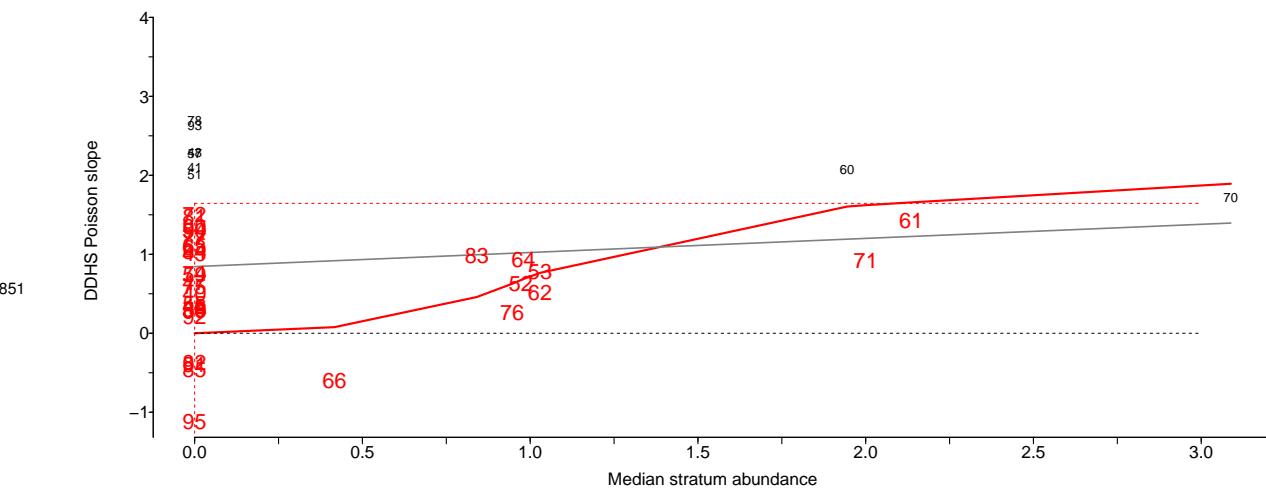


Figure 7.19F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Monkfish.

852

## 7.20 Ocean pout (Loquette d'Amérique) - species code 640 (category LF)

853

Scientific name: [Zoarces americanus](#)

854

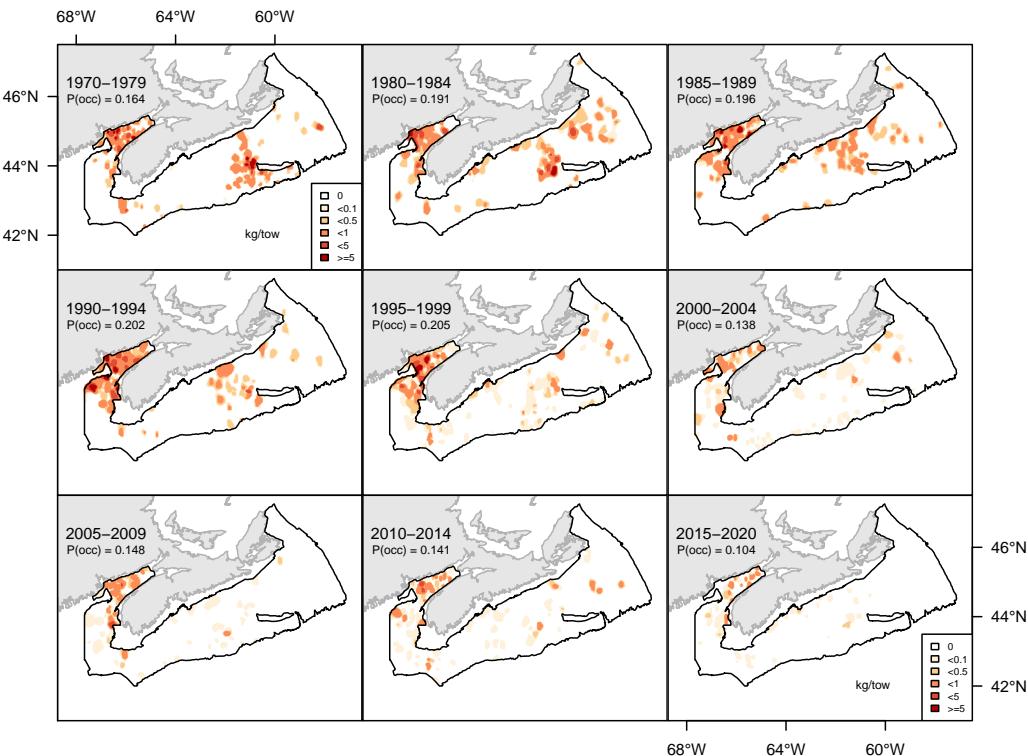


Figure 7.20A. Inverse distance weighted distribution of catch biomass (kg/tow) for Ocean pout.

855

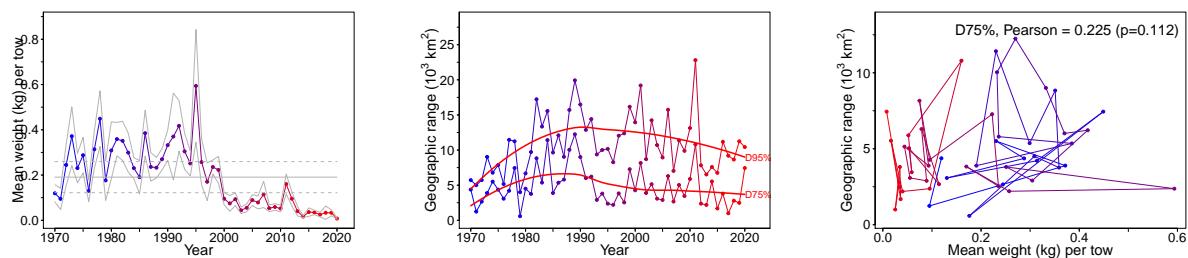


Figure 7.20B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Ocean pout.

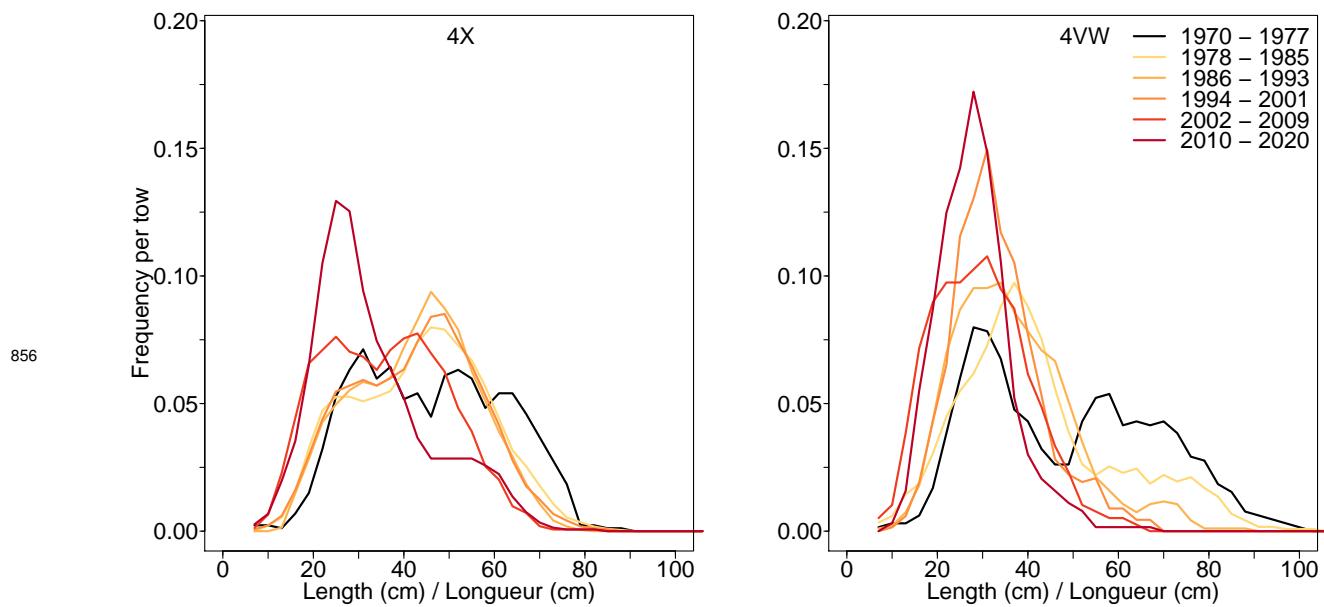


Figure 7.20C. Length frequency distribution in NAFO units 4X and 4VW for Ocean pout.

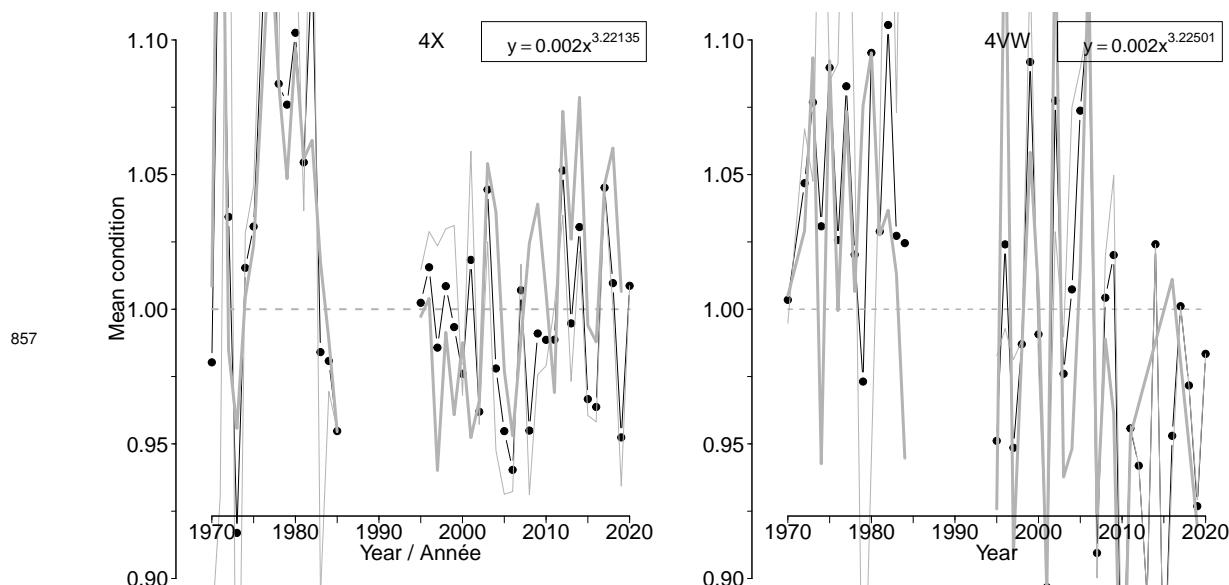
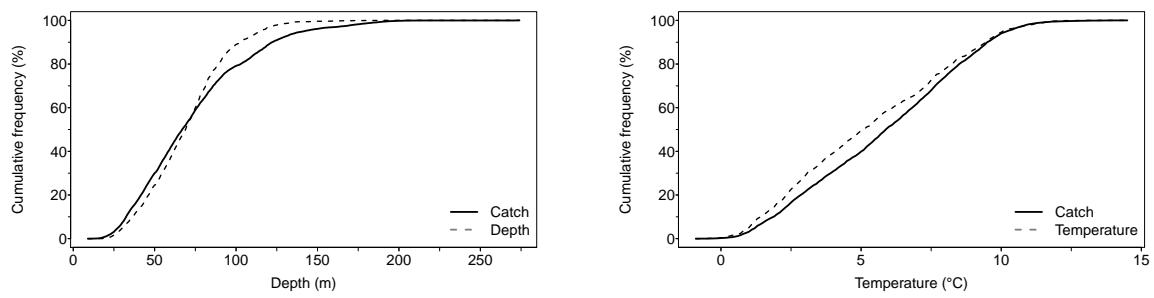
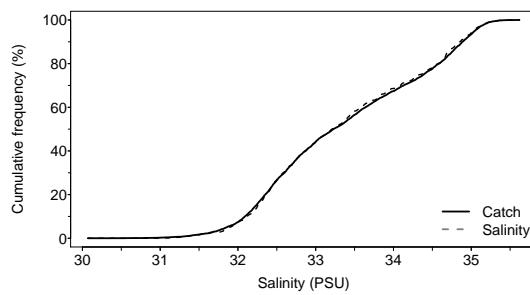


Figure 7.20D. Average fish condition in NAFO units 4X and 4VW for Ocean pout.



858



Freq	Depth	Temp	Sal
F5	31	1.0	31.00
F25	52	2.8	32.46
F50	69	5.1	33.22
F75	85	7.7	34.34
F95	116	10.0	35.03

Figure 7.20E. Catch distribution by depth, temperature and salinity of Ocean pout.

859

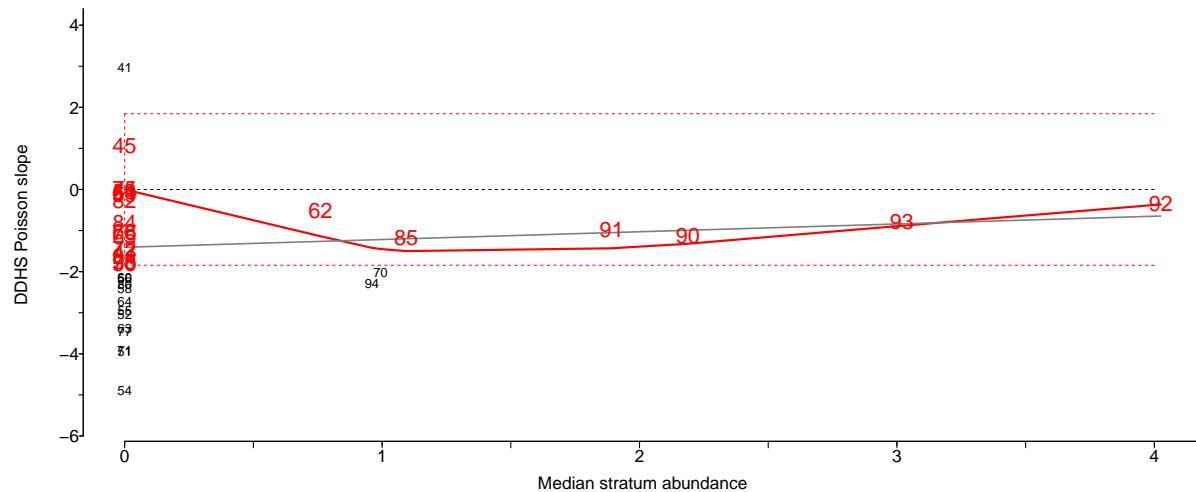


Figure 7.20F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Ocean pout.

860      **7.21 Thorny skate (Raie épineuse) - species code 201 (category LF)**

861      Scientific name: [Amblyraja radiata](#)

862

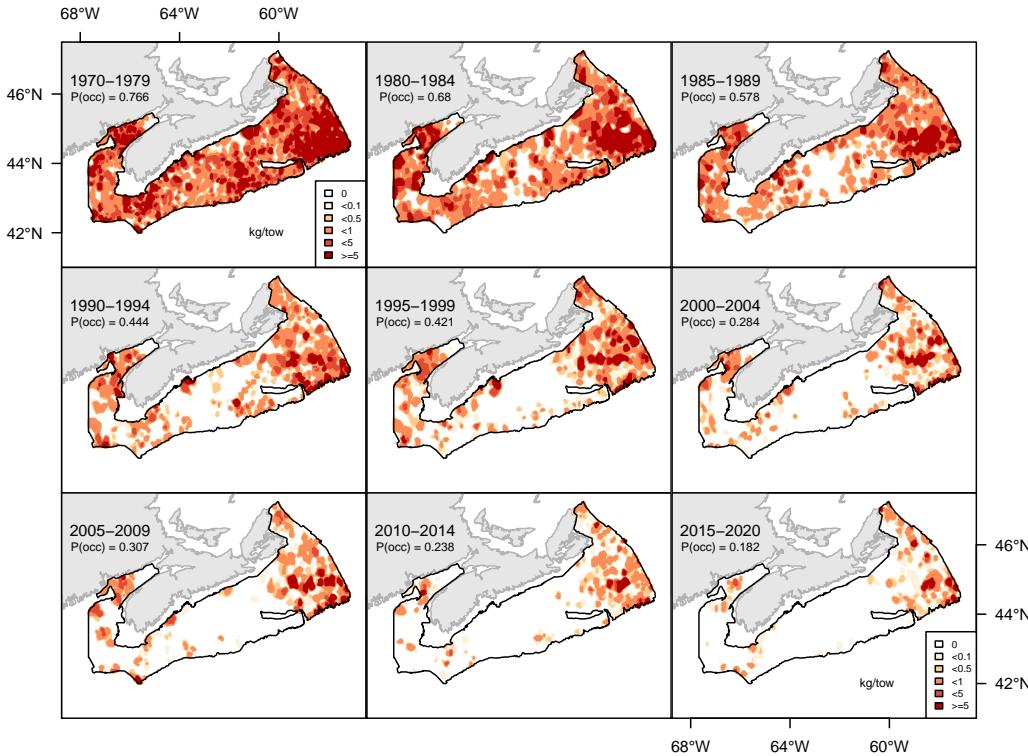


Figure 7.21A. Inverse distance weighted distribution of catch biomass (kg/tow) for Thorny skate.

863

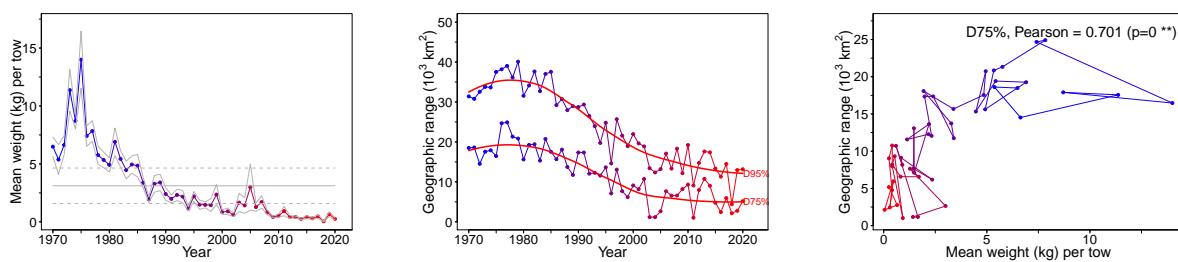


Figure 7.21B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Thorny skate.

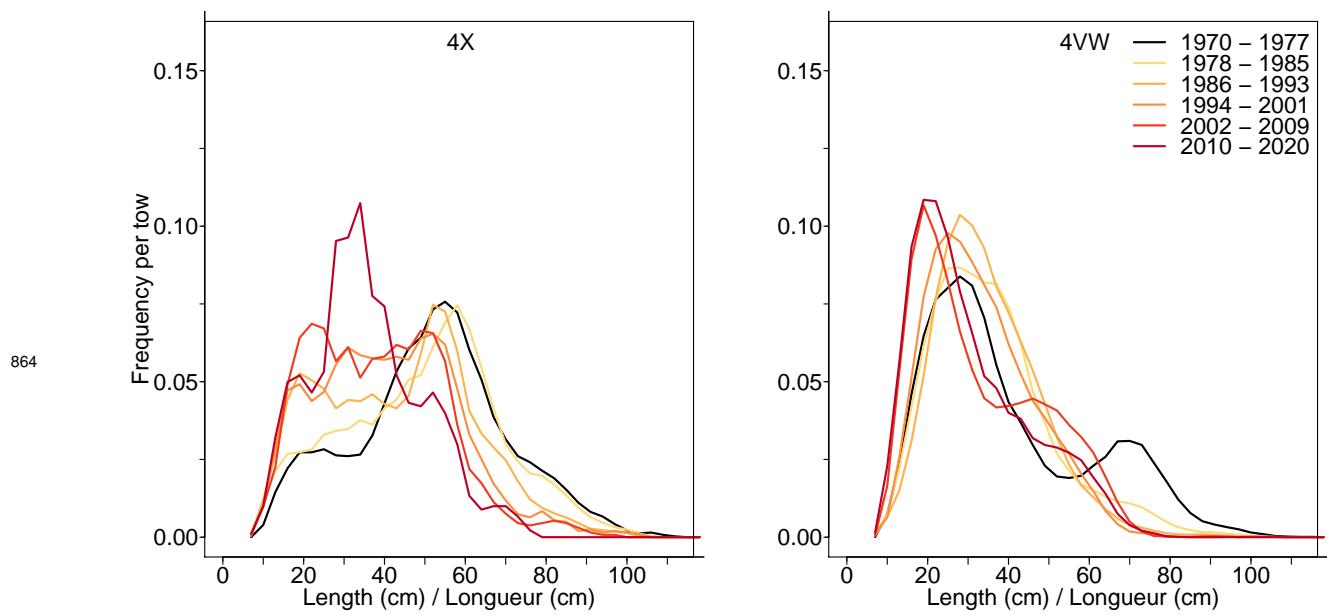


Figure 7.21C. Length frequency distribution in NAFO units 4X and 4VW for Thorny skate.

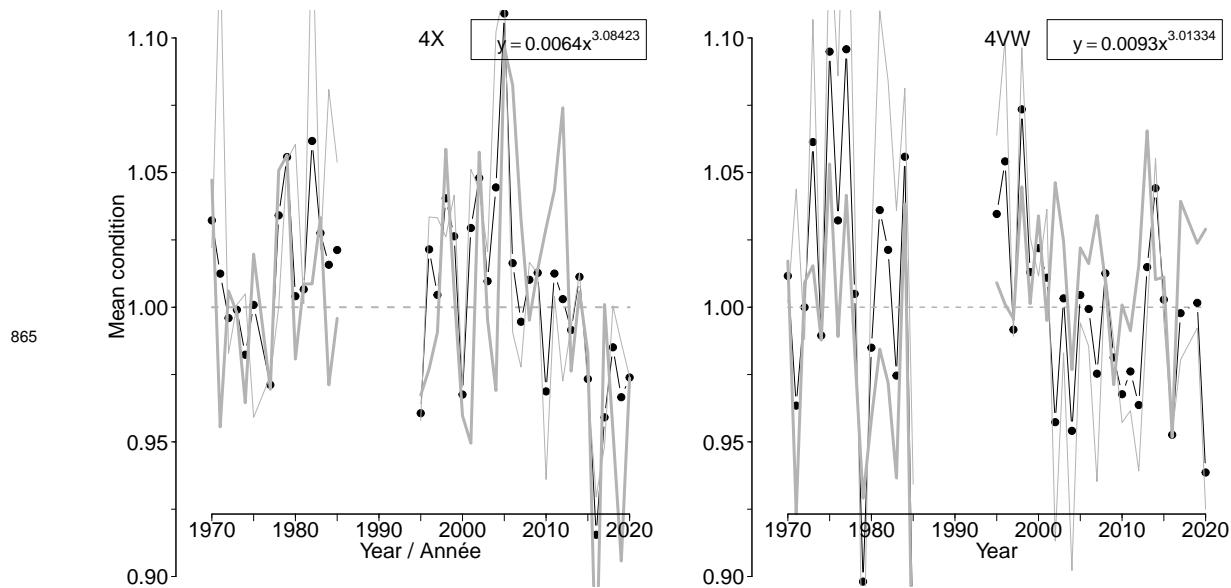
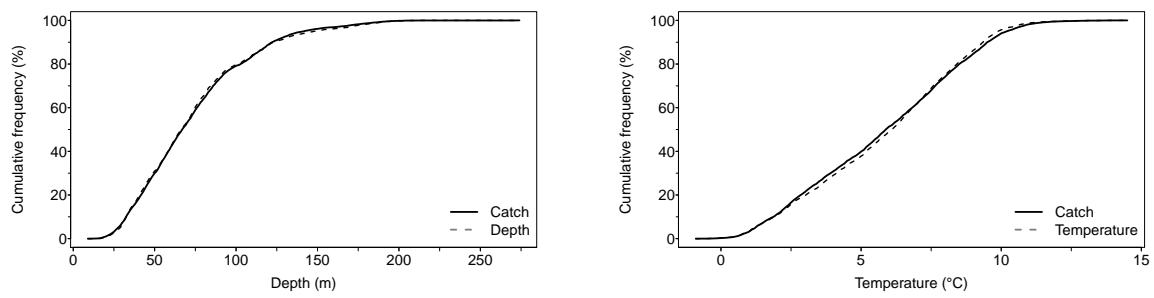
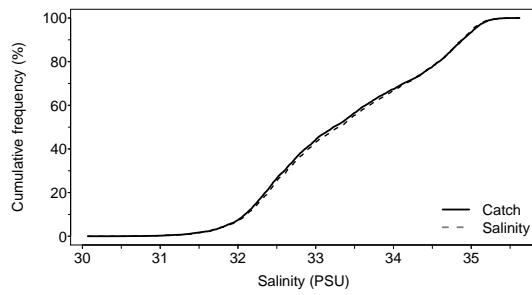


Figure 7.21D. Average fish condition in NAFO units 4X and 4VW for Thorny skate.

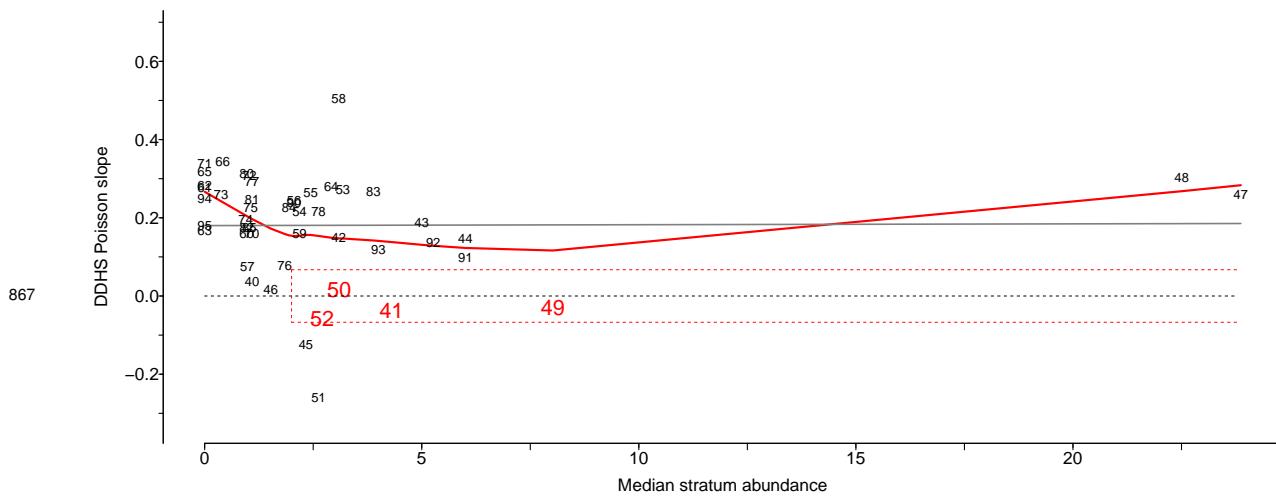


866



Freq	Depth	Temp	Sal
F5	29	1.3	31.00
F25	45	3.7	32.50
F50	67	6.2	33.30
F75	91	8.1	34.40
F95	148	9.9	35.03

Figure 7.21E. Catch distribution by depth, temperature and salinity of Thorny skate.



867

Figure 7.21F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Thorny skate.

868

## 7.22 Smooth skate (Raie lisse) - species code 202 (category LF)

869

Scientific name: [Malacoraja senta](#)

870

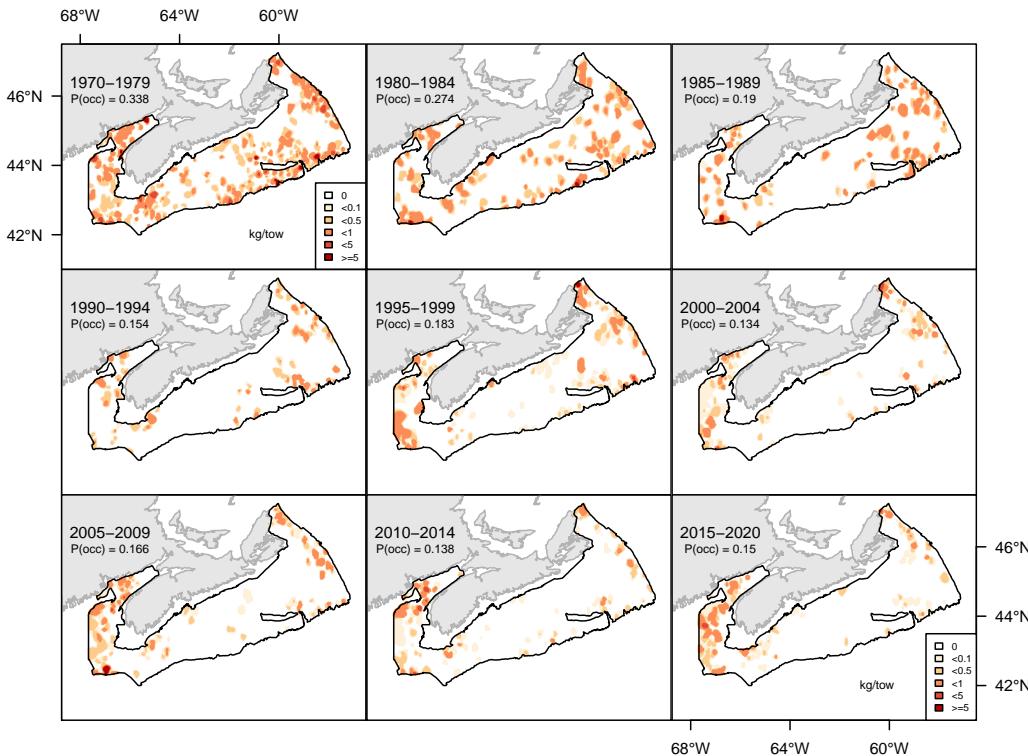


Figure 7.22A. Inverse distance weighted distribution of catch biomass (kg/tow) for Smooth skate.

871

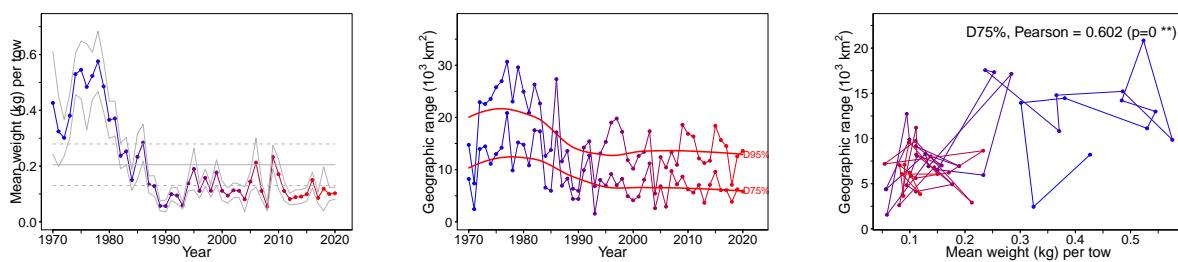


Figure 7.22B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Smooth skate.

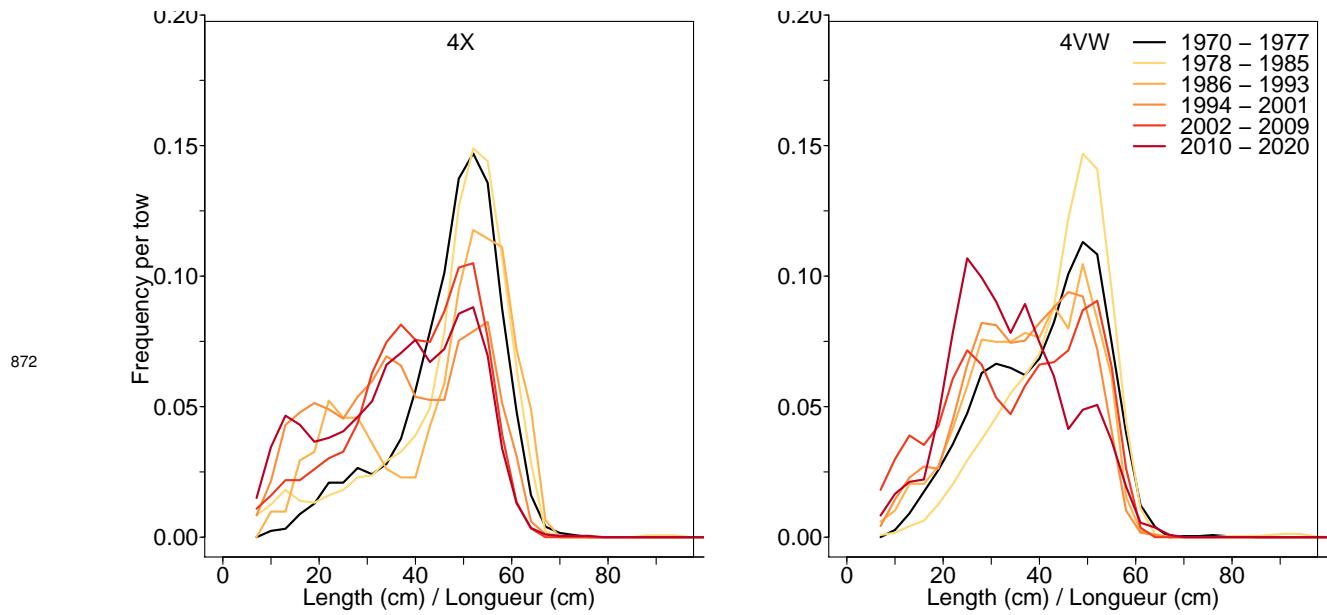


Figure 7.22C. Length frequency distribution in NAFO units 4X and 4VW for Smooth skate.

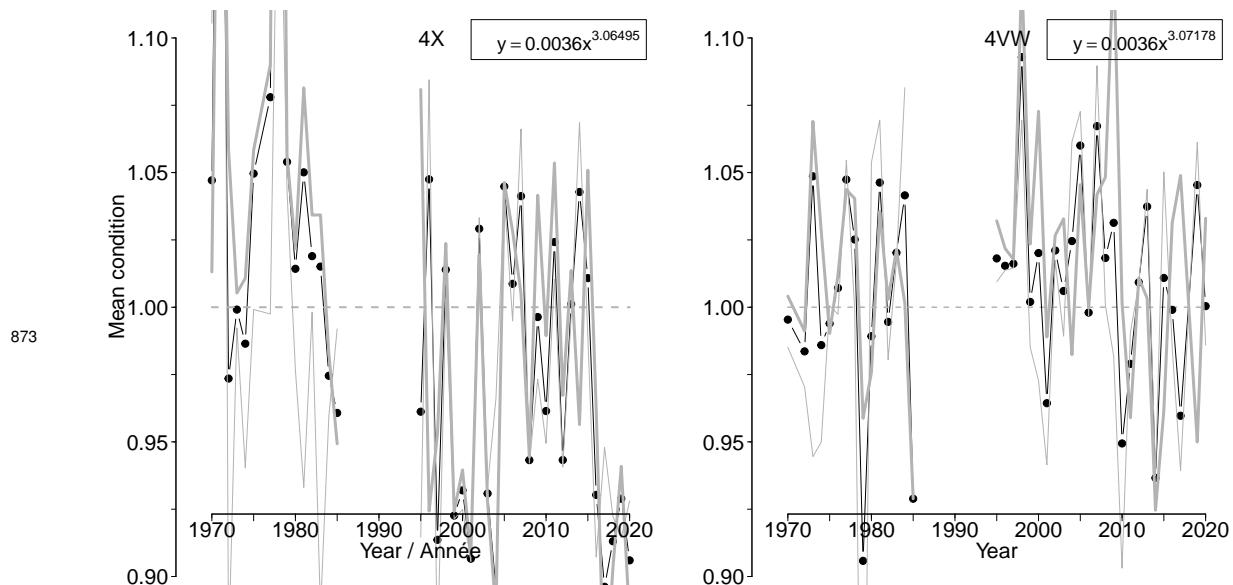
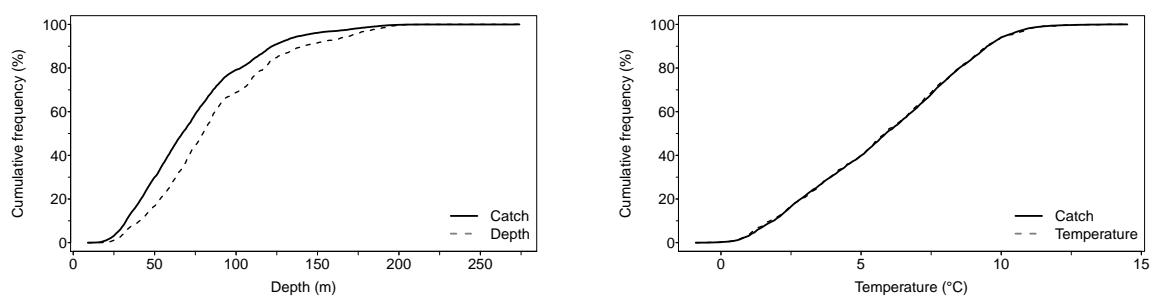
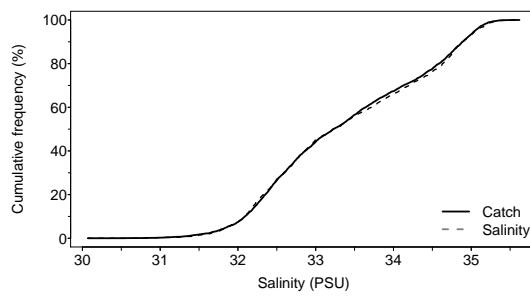


Figure 7.22D. Average fish condition in NAFO units 4X and 4VW for Smooth skate.



874



Freq	Depth	Temp	Sal
F5	33	1.2	31.00
F25	59	3.5	32.47
F50	80	5.9	33.23
F75	110	8.1	34.45
F95	171	10.0	35.06

Figure 7.22E. Catch distribution by depth, temperature and salinity of Smooth skate.

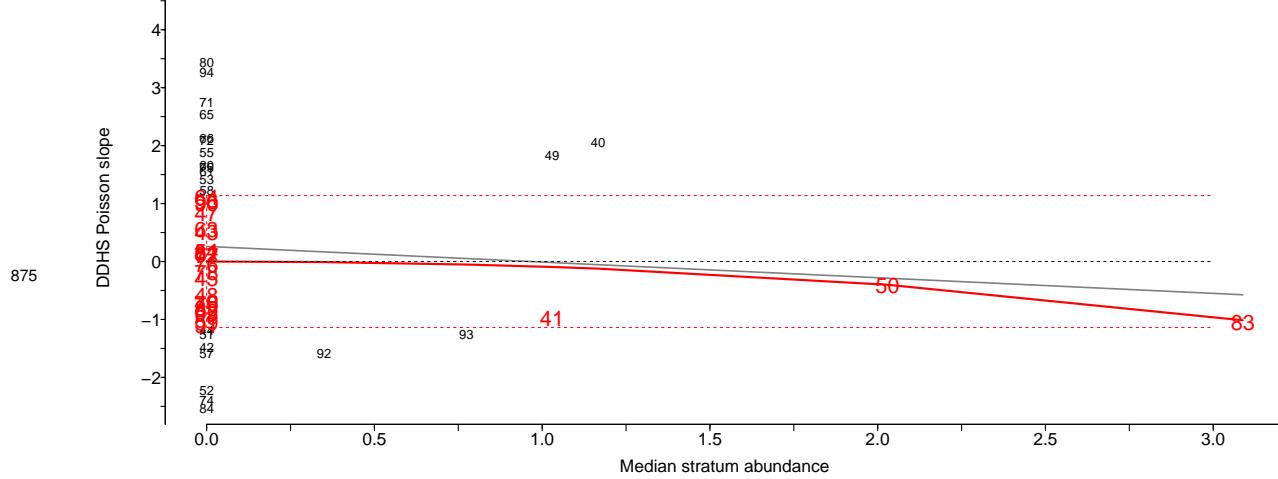


Figure 7.22F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Smooth skate.

876

## 7.23 Winter skate (Raie tachetée) - species code 204 (category LF)

877

Scientific name: [Leucoraja ocellata](#)

878

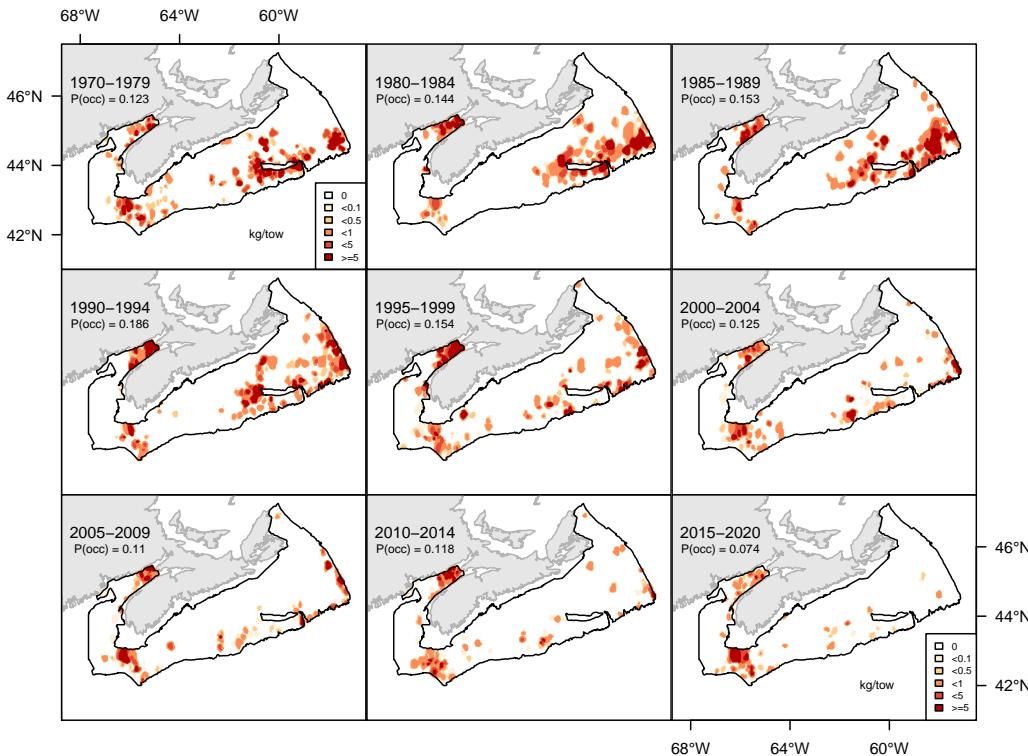


Figure 7.23A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter skate.

879

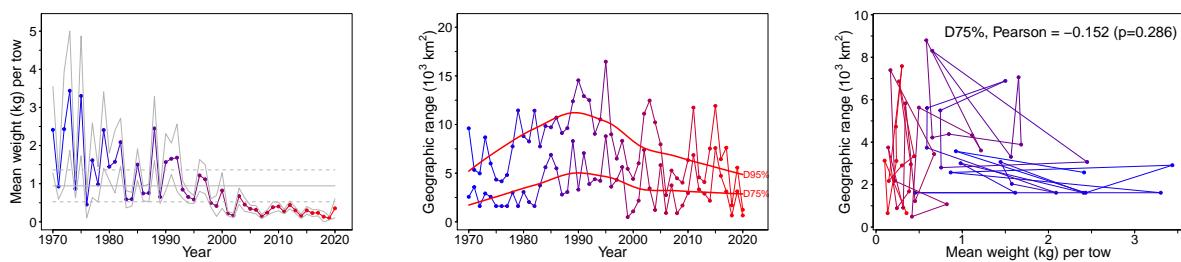


Figure 7.23B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter skate.

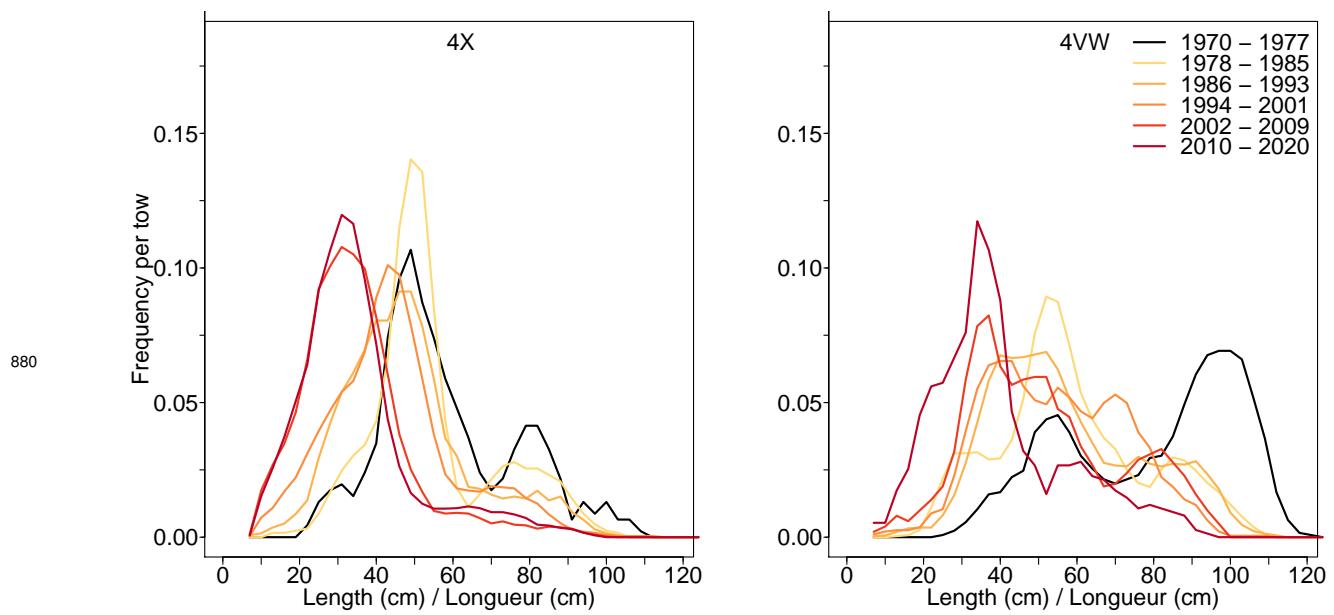


Figure 7.23C. Length frequency distribution in NAFO units 4X and 4VW for Winter skate.

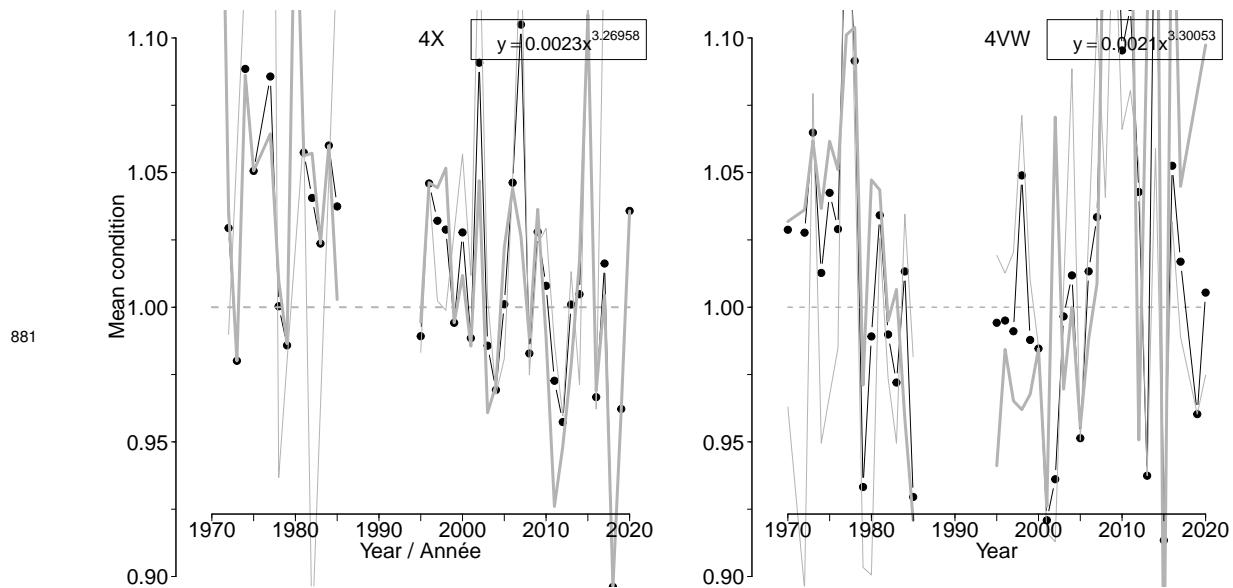
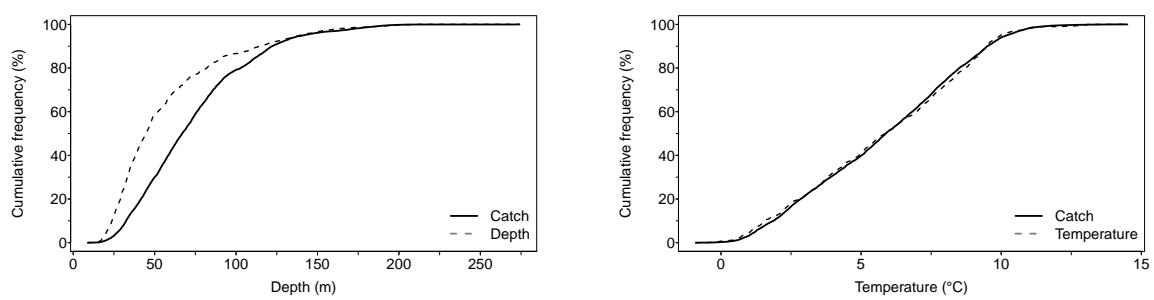
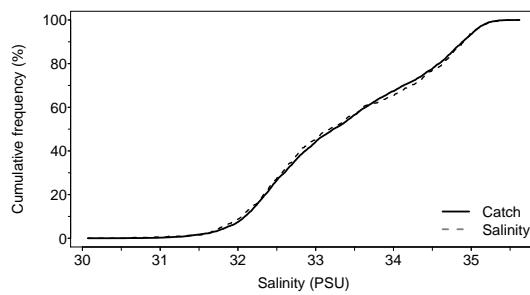


Figure 7.23D. Average fish condition in NAFO units 4X and 4VW for Winter skate.



882



Freq	Depth	Temp	Sal
F5	21	1.1	31.00
F25	32	3.5	32.44
F50	45	5.9	33.19
F75	71	8.3	34.42
F95	140	10.0	35.03

Figure 7.23E. Catch distribution by depth, temperature and salinity of Winter skate.

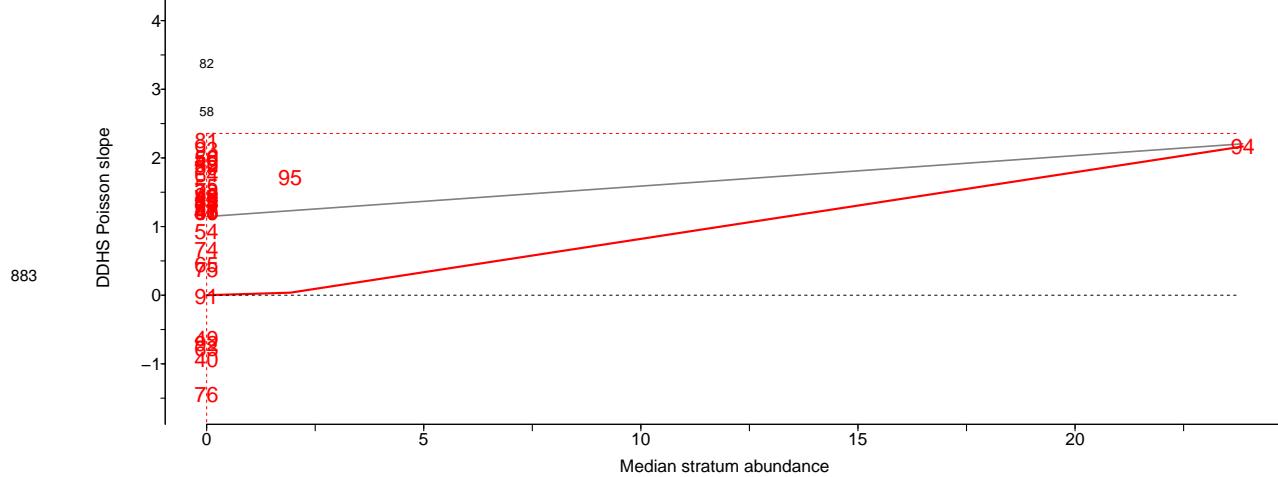


Figure 7.23F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter skate.

884      **7.24 Picked dogfish (Aiguillat commun) - species code 220 (category LF)**

885      Scientific name: [Squalus acanthias](#)

886

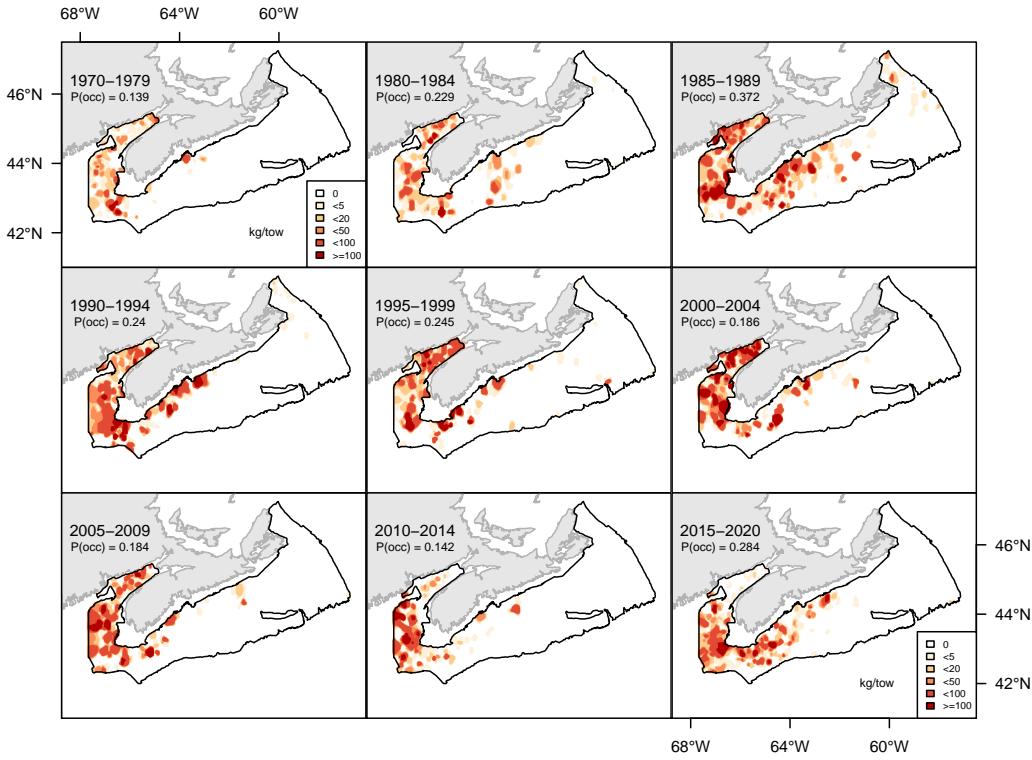


Figure 7.24A. Inverse distance weighted distribution of catch biomass (kg/tow) for Picked dogfish.

887

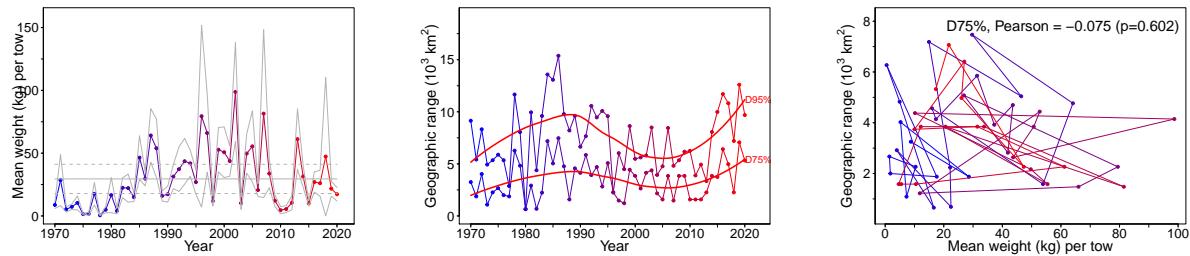


Figure 7.24B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Picked dogfish.

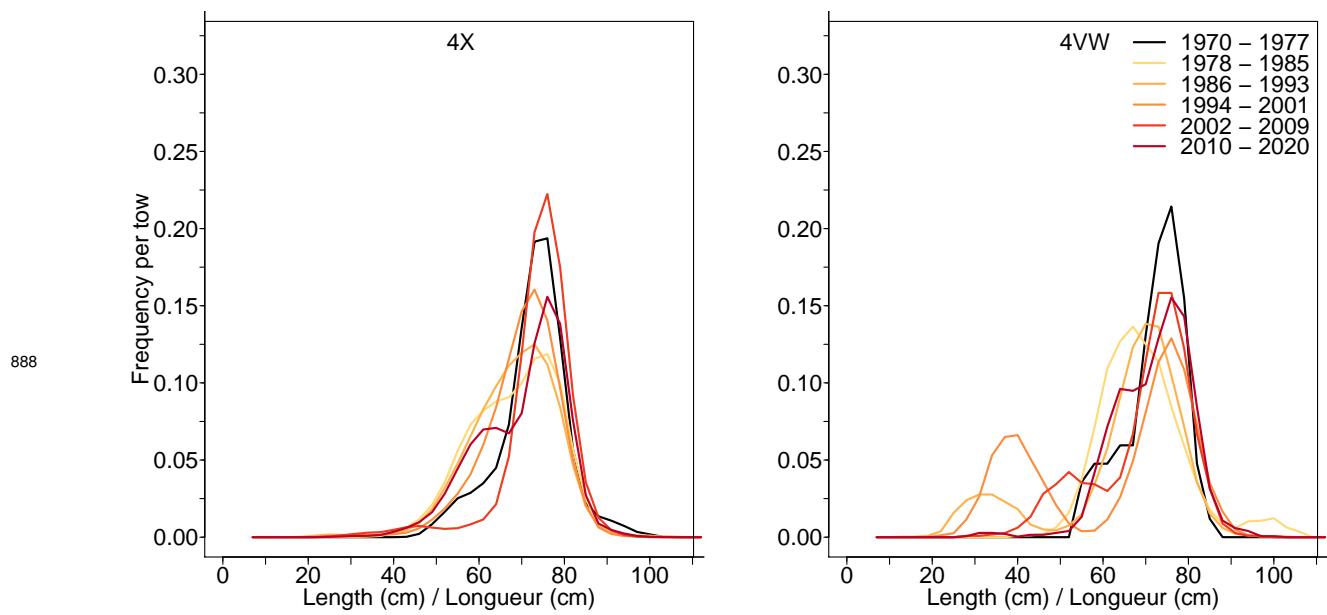


Figure 7.24C. Length frequency distribution in NAFO units 4X and 4VW for Picked dogfish.

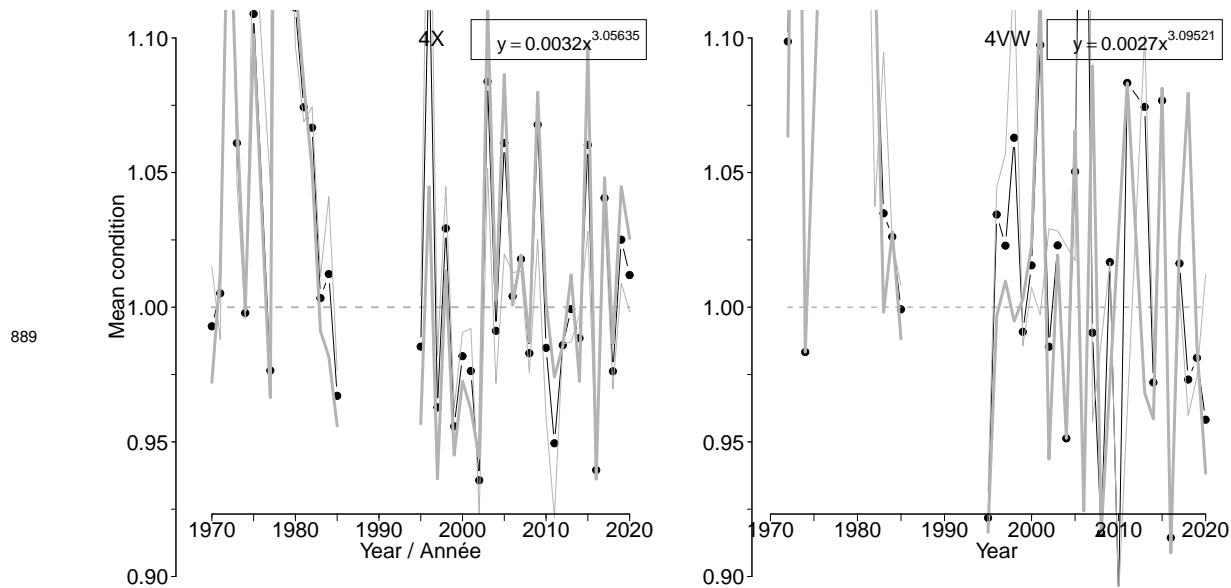
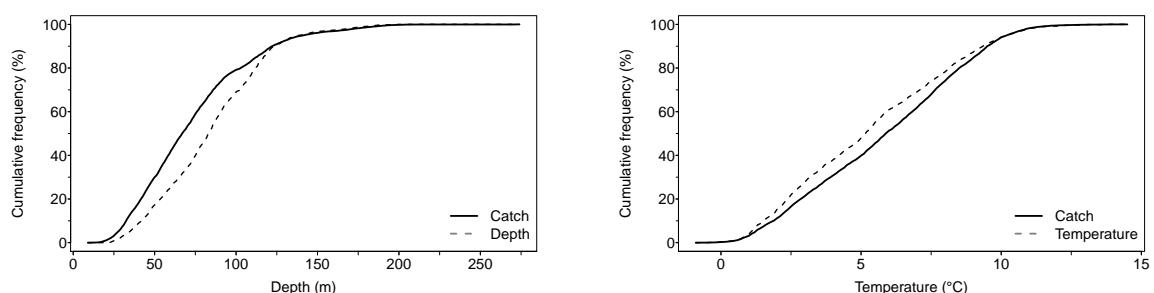
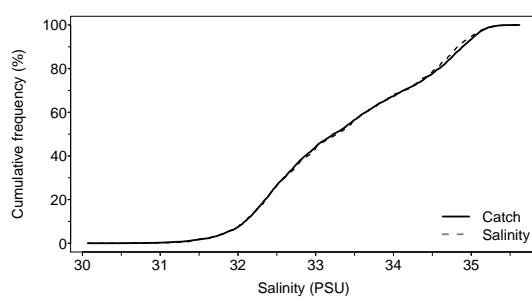


Figure 7.24D. Average fish condition in NAFO units 4X and 4VW for Picked dogfish.



890



Freq	Depth	Temp	Sal
F5	35	1.1	31.00
F25	60	2.8	32.47
F50	83	5.2	33.28
F75	108	7.7	34.37
F95	139	10.0	35.02

Figure 7.24E. Catch distribution by depth, temperature and salinity of Picked dogfish.

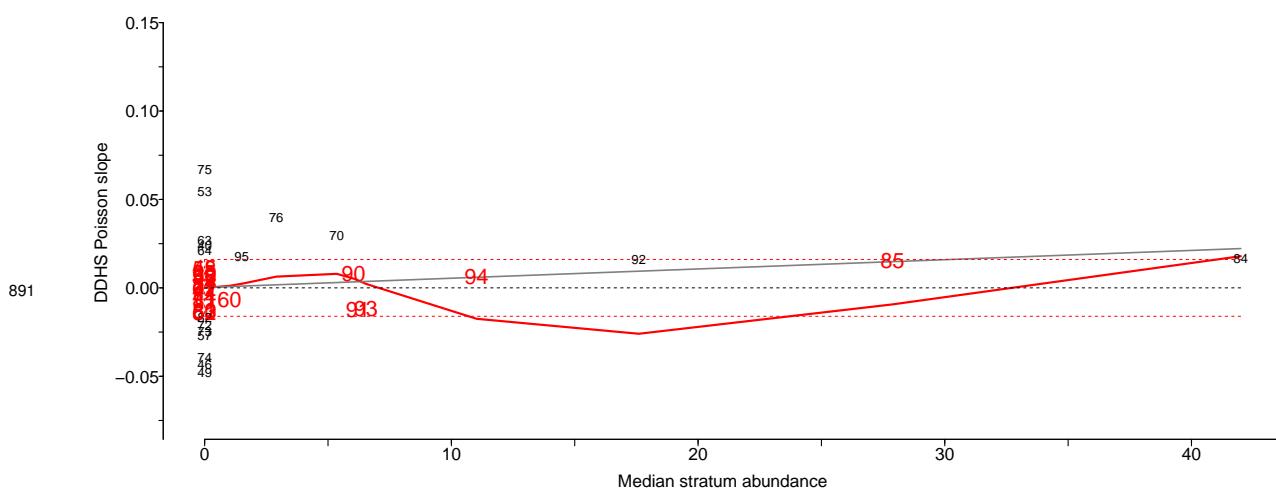


Figure 7.24F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Picked dogfish.

892      **7.25 Northern shortfin squid (*Encornet rouge nordique*) - species code 4511 (category  
893      LF)**

894      Scientific name: [Illex illecebrosus](#)

895

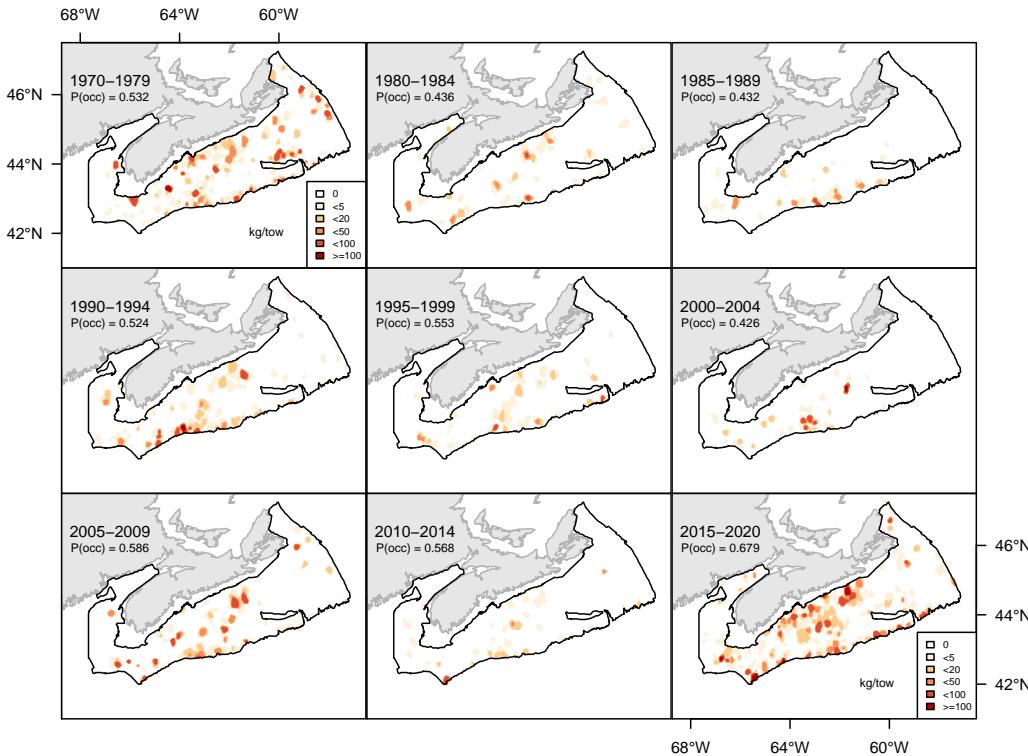


Figure 7.25A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern shortfin squid.

896

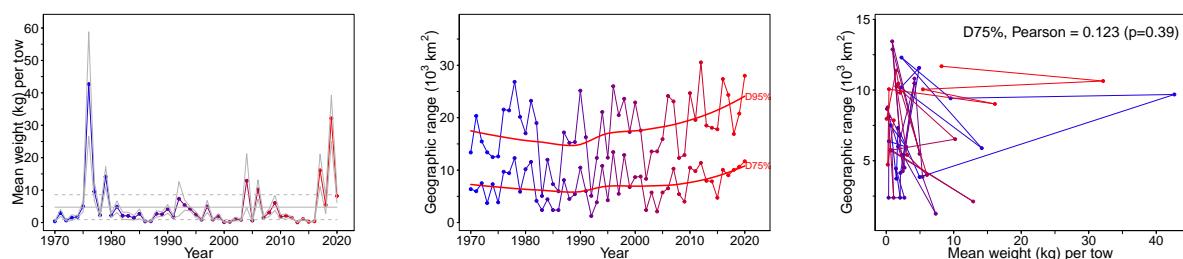


Figure 7.25B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern shortfin squid.

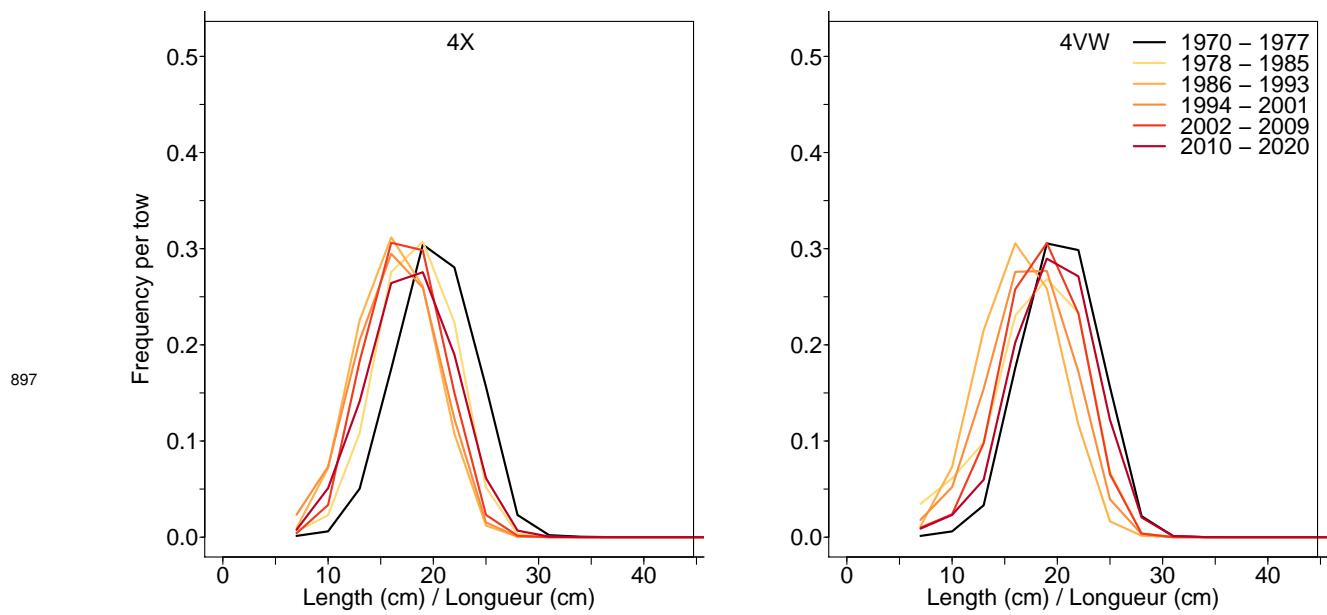


Figure 7.25C. Length frequency distribution in NAFO units 4X and 4VW for Northern shortfin squid.

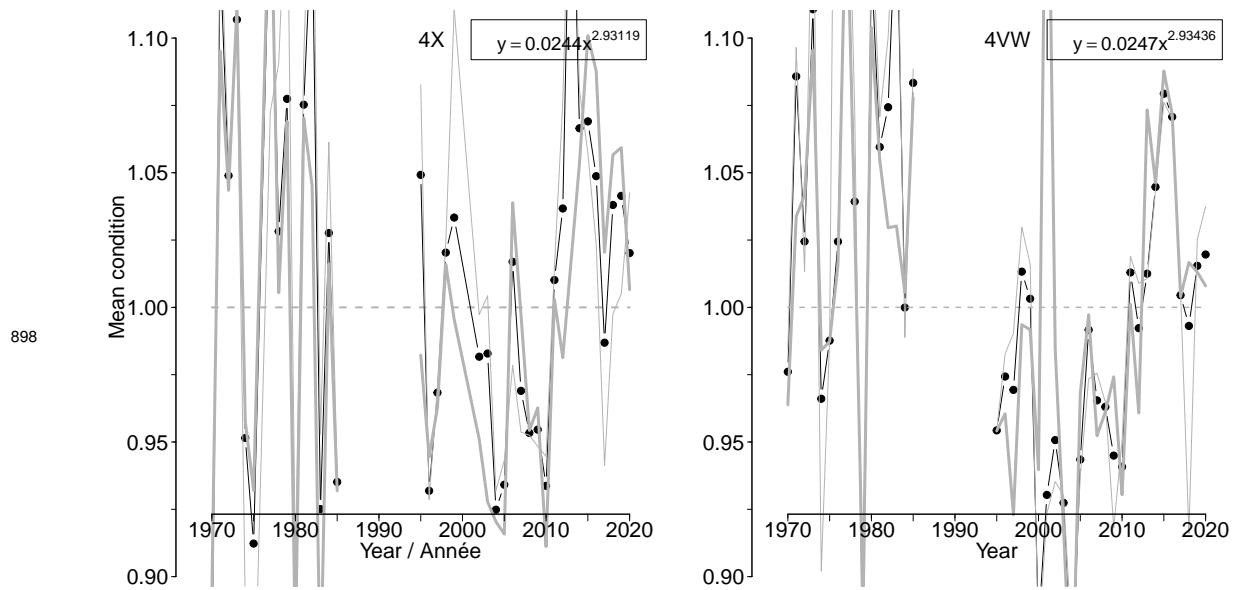
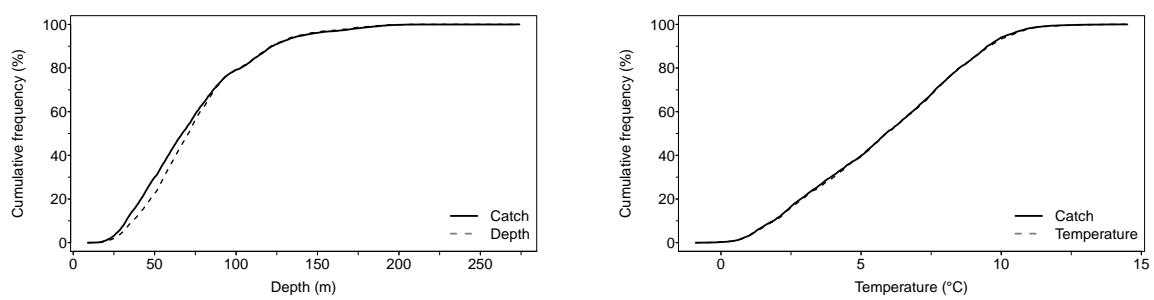
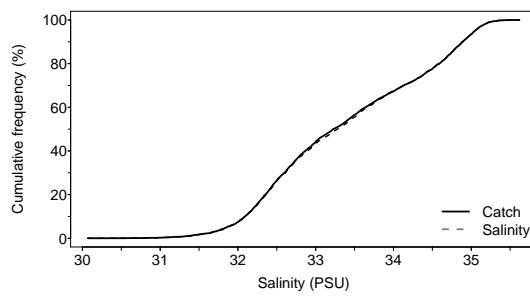


Figure 7.25D. Average fish condition in NAFO units 4X and 4VW for Northern shortfin squid.



899



Freq	Depth	Temp	Sal
F5	31	1.3	31.00
F25	53	3.5	32.48
F50	71	5.9	33.28
F75	93	8.1	34.39
F95	139	10.0	35.05

Figure 7.25E. Catch distribution by depth, temperature and salinity of Northern shortfin squid.

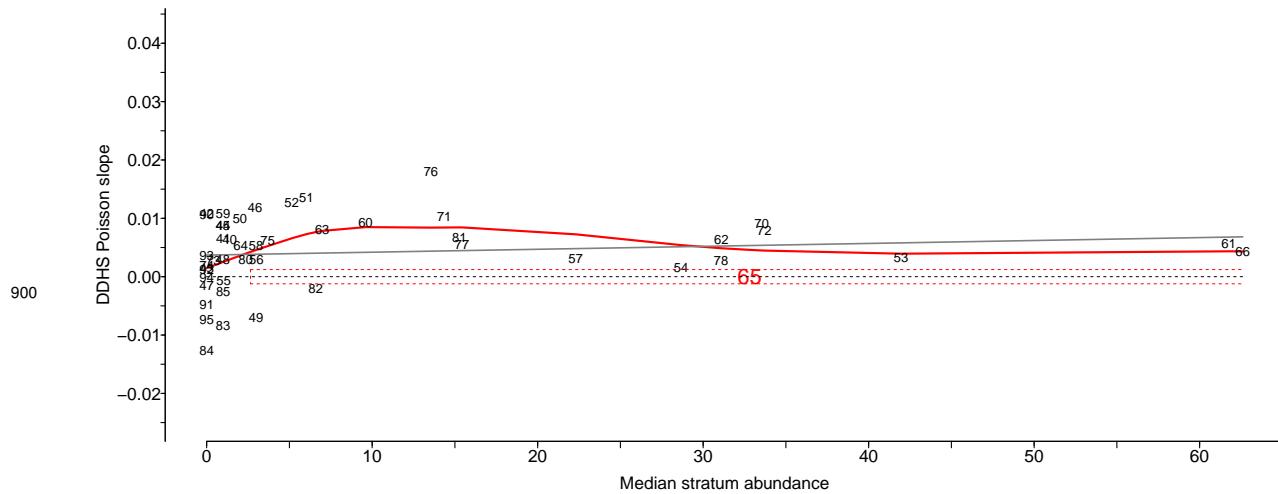


Figure 7.25F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Northern shortfin squid.

901      **7.26 Atlantic hagfish (*Myxine du nord*) - species code 241 (category LI)**

902      Scientific name: [Myxine glutinosa](#)

903

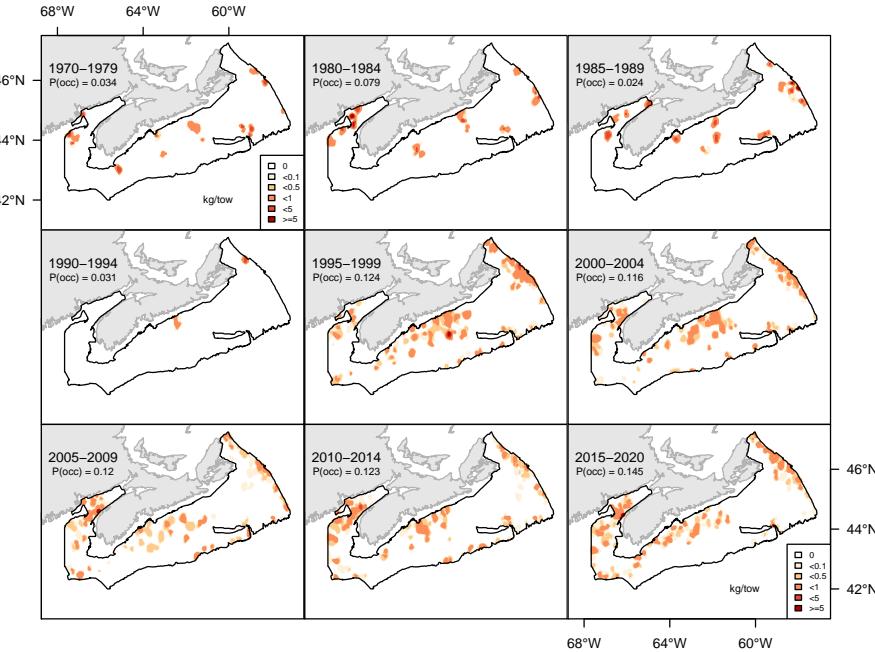


Figure 7.26A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic hagfish.

904

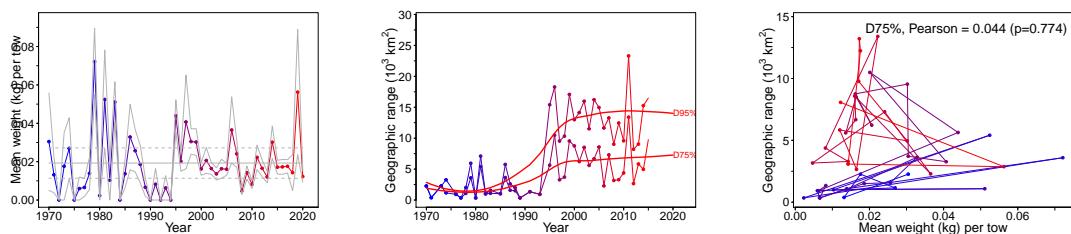


Figure 7.26B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hagfish.

905      **7.27 Cusk (Brosme) - species code 15 (category LI)**

906      Scientific name: [Brosme brosme](#)

907

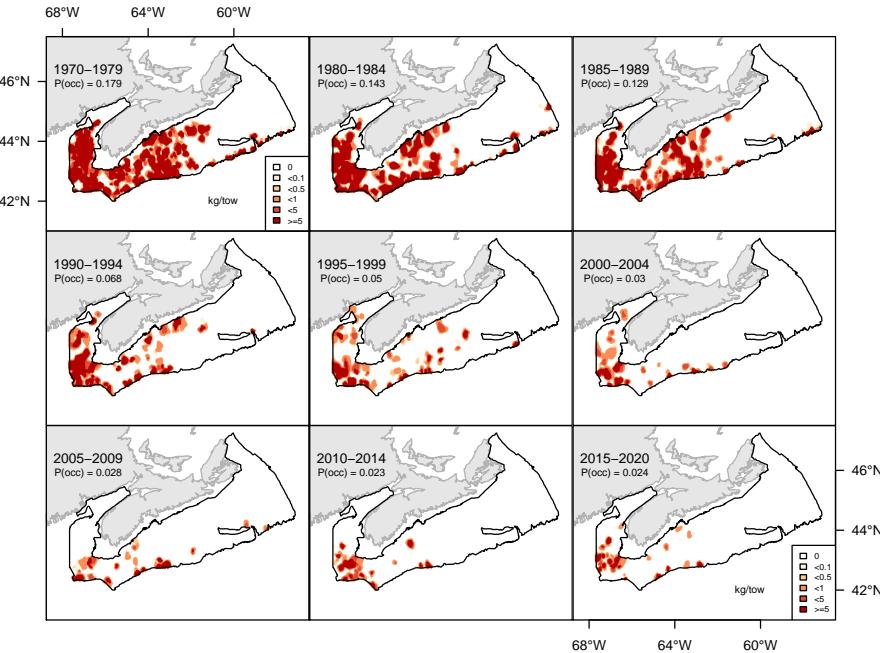


Figure 7.27A. Inverse distance weighted distribution of catch biomass (kg/tow) for Cusk.

908

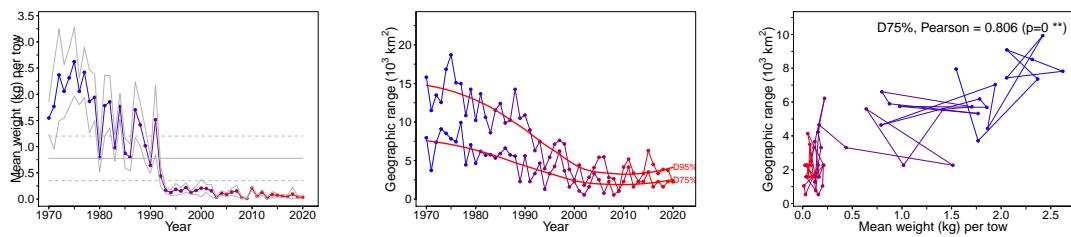


Figure 7.27B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Cusk.

909      **7.28 Greenland halibut (Flétan noir) - species code 31 (category LI)**

910      Scientific name: [Reinhardtius hippoglossoides](#)

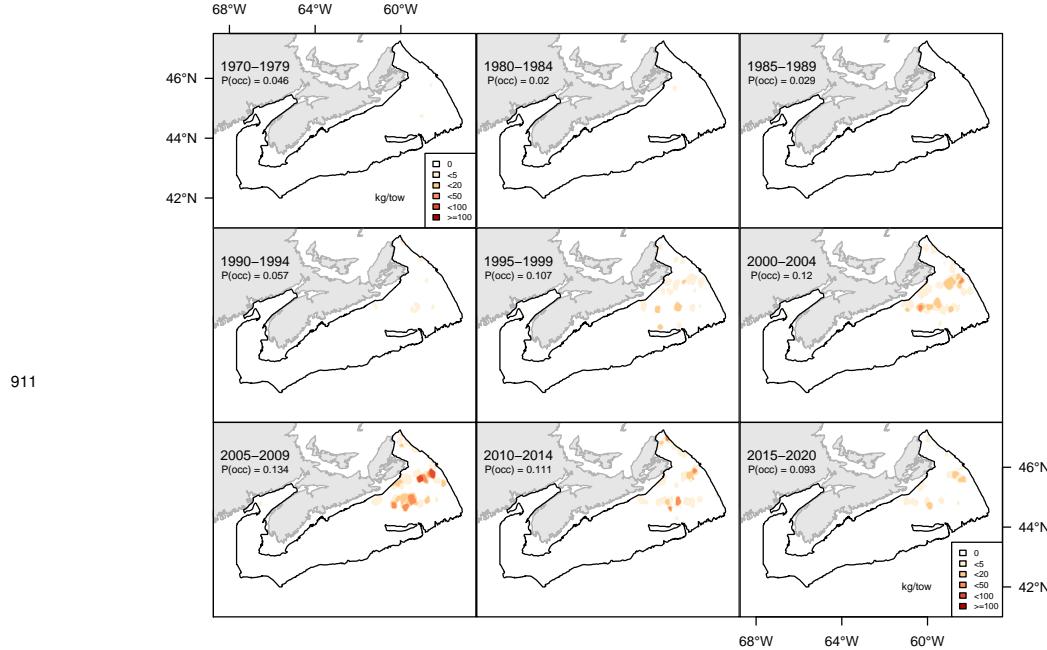


Figure 7.28A. Inverse distance weighted distribution of catch biomass (kg/tow) for Greenland halibut.

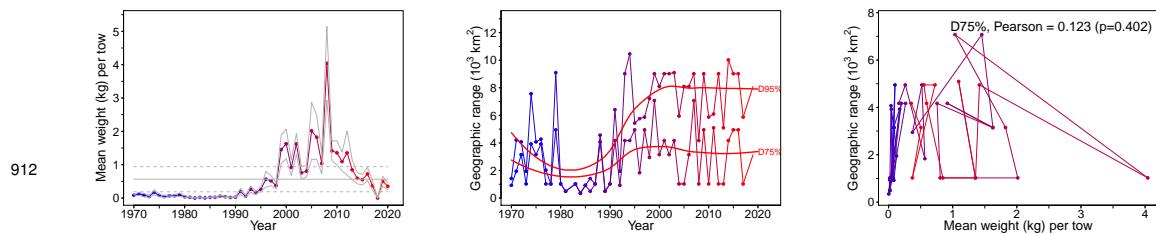


Figure 7.28B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greenland halibut.

913

## 7.29 Gulf Stream flounder (Plie du Gulf Stream) - species code 44 (category LI)

914

Scientific name: [Citharichthys arctifrons](#)

915

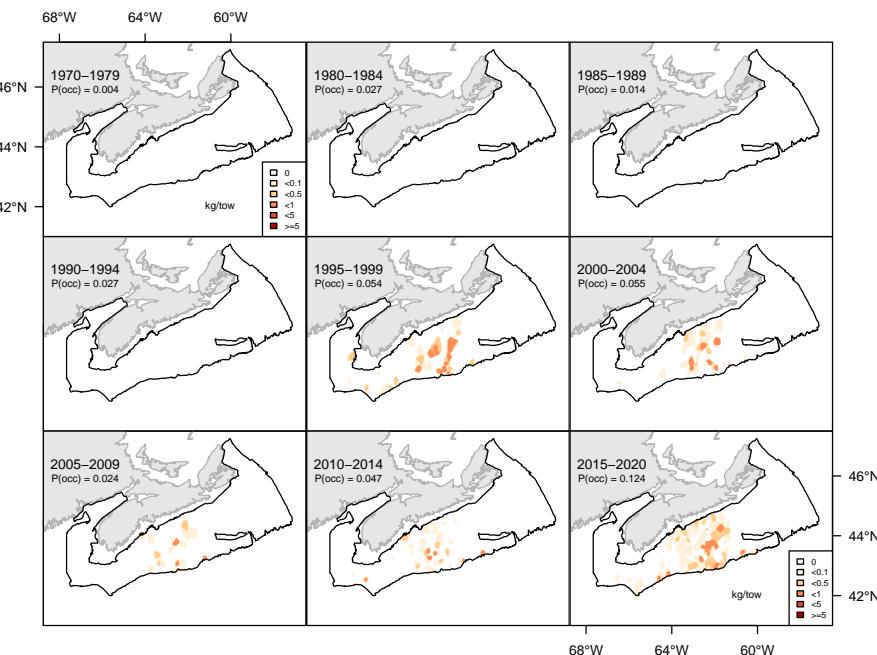


Figure 7.29A. Inverse distance weighted distribution of catch biomass (kg/tow) for Gulf Stream flounder.

916

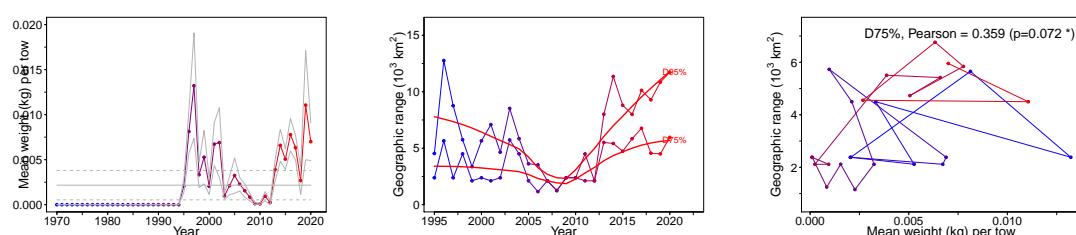


Figure 7.29B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Gulf Stream flounder.

917

### 7.30 American shad (*Alose savoureuse*) - species code 61 (category LI)

918

Scientific name: [Alosa sapidissima](#)

919

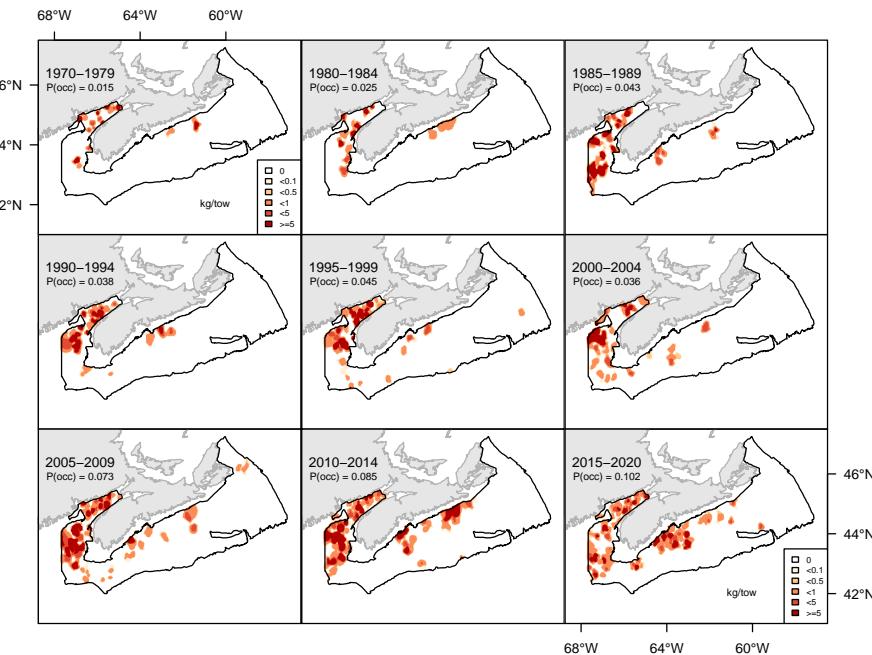


Figure 7.30A. Inverse distance weighted distribution of catch biomass (kg/tow) for American shad.

920

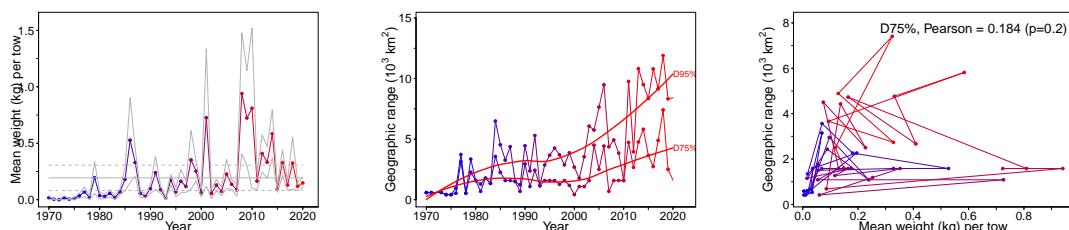


Figure 7.30B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American shad.

921

### 7.31 Alewife (Gaspareau) - species code 62 (category LI)

922

Scientific name: *Alosa pseudoharengus*

923

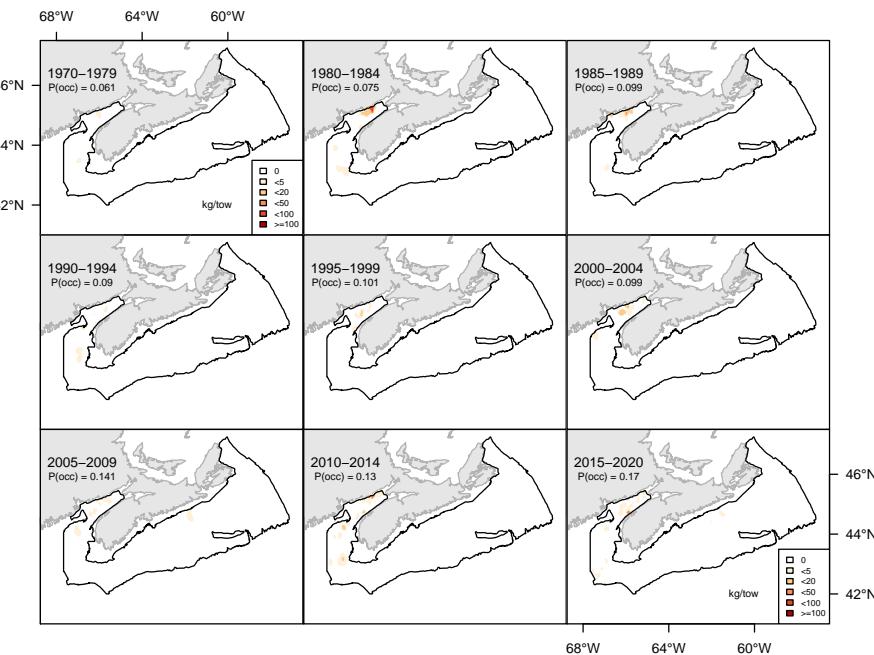


Figure 7.31A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alewife.

924

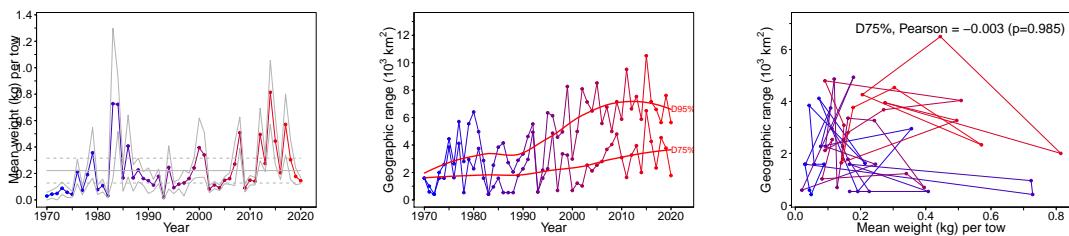


Figure 7.31B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alewife.

925

### 7.32 Capelin (Capelan) - species code 64 (category LI)

926

Scientific name: [Mallotus villosus](#)

927

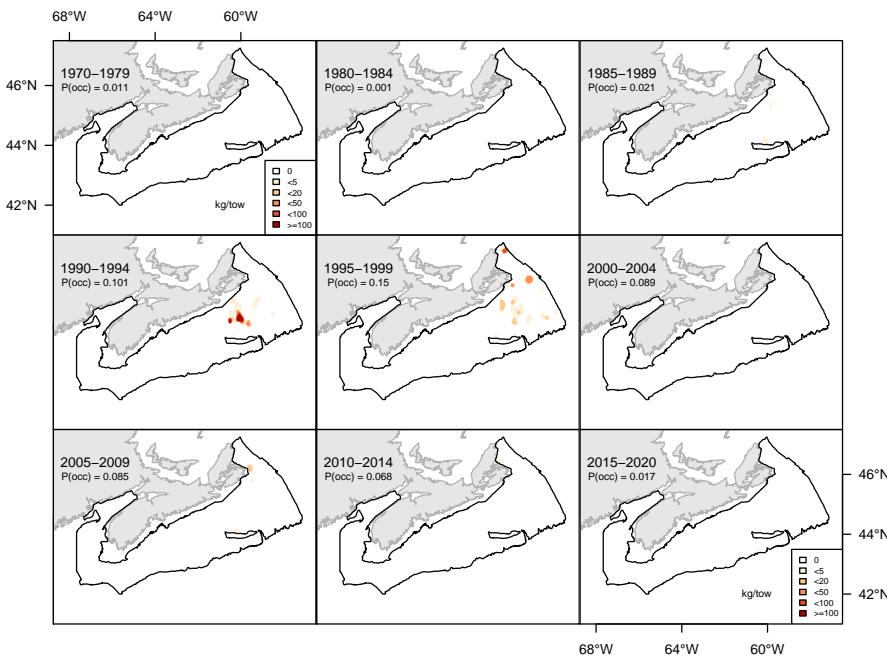


Figure 7.32A. Inverse distance weighted distribution of catch biomass (kg/tow) for Capelin.

928

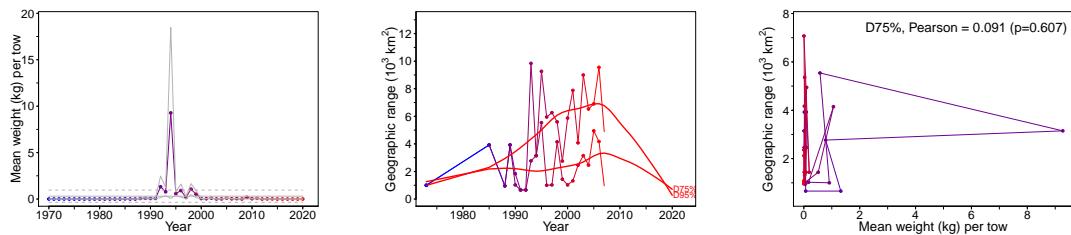


Figure 7.32B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Capelin.

929      **7.33 Atlantic mackerel (*Maquereau commun*) - species code 70 (category LI)**

930      Scientific name: *Scomber scombrus*

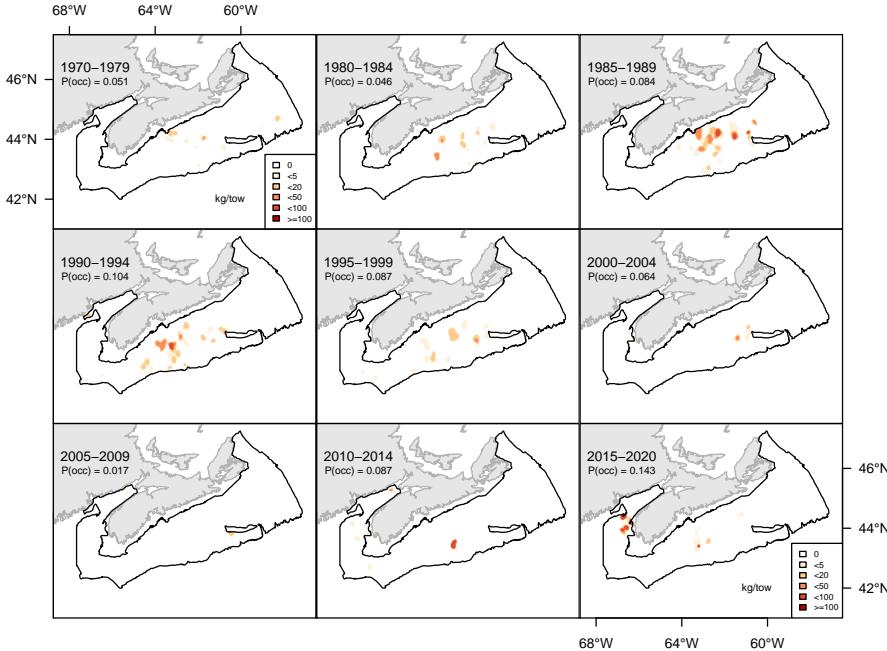


Figure 7.33A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic mackerel.

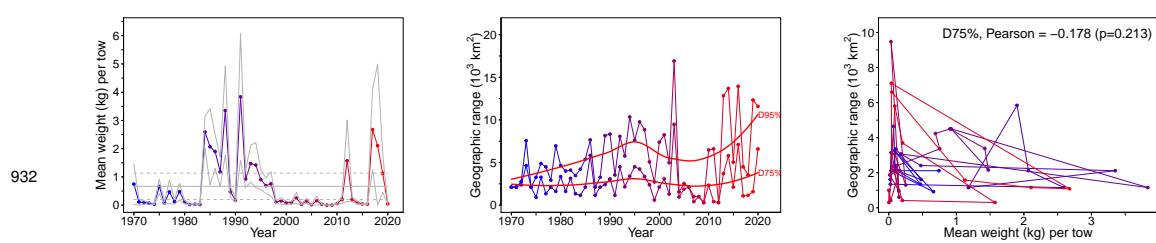


Figure 7.33B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic mackerel.

933

### 7.34 Longfin hake (*Merluche à longues nageoires*) - species code 112 (category LI)

934

Scientific name: [Phycis chesteri](#)

935

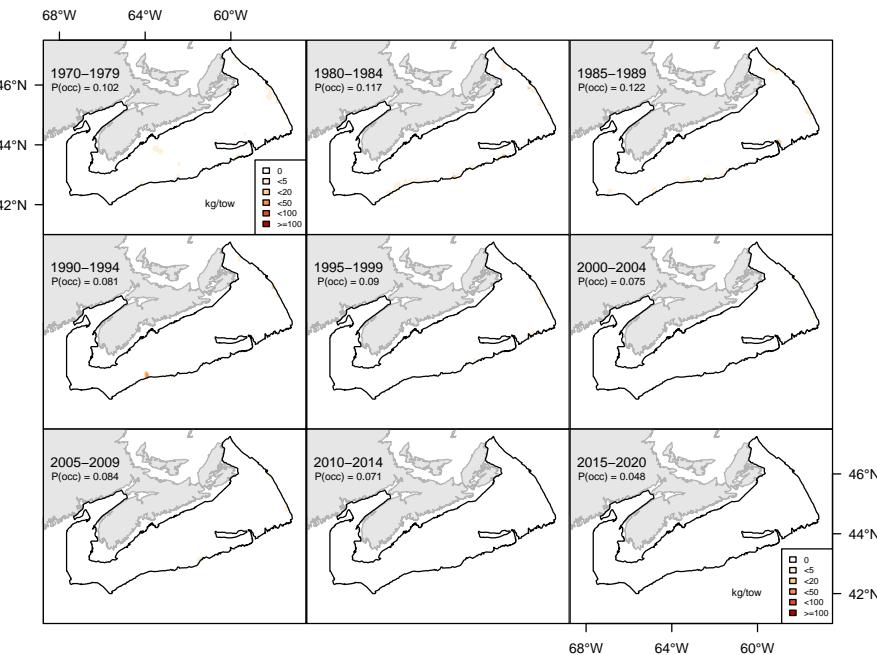


Figure 7.34A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longfin hake.

936

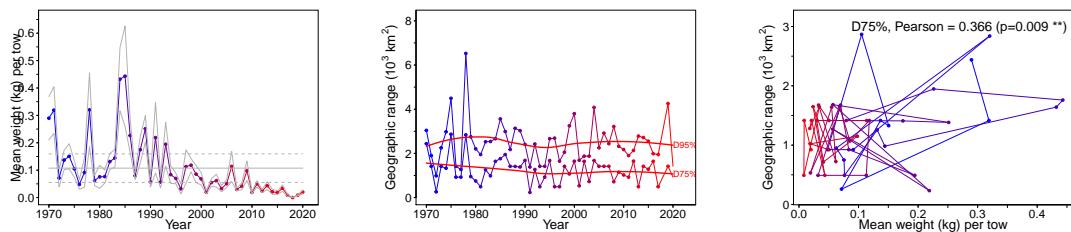


Figure 7.34B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longfin hake.

937

### 7.35 Fourbeard rockling (Motelle à quatre barbillons) - species code 114 (category LI)

938

Scientific name: [Enchelyopus cimbrius](#)

939

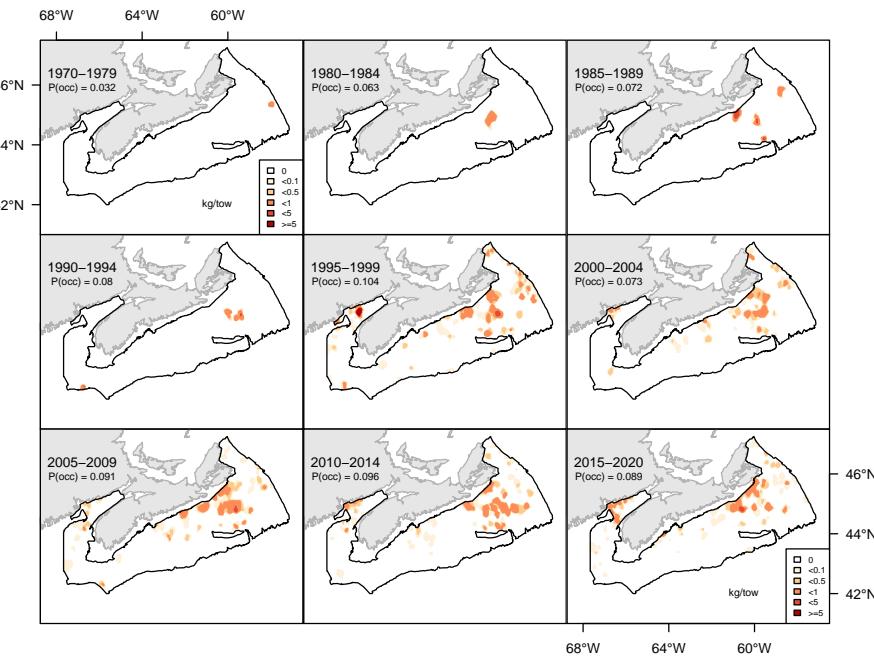


Figure 7.35A. Inverse distance weighted distribution of catch biomass (kg/tow) for Fourbeard rockling.

940

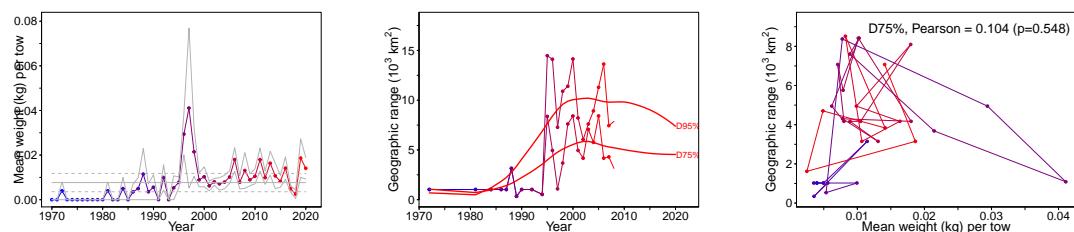


Figure 7.35B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Fourbeard rockling.

941

### 7.36 Blackbelly rosefish (Sébaste chèvre) - species code 123 (category LI)

942

Scientific name: [Helicolenus dactylopterus](#)

943

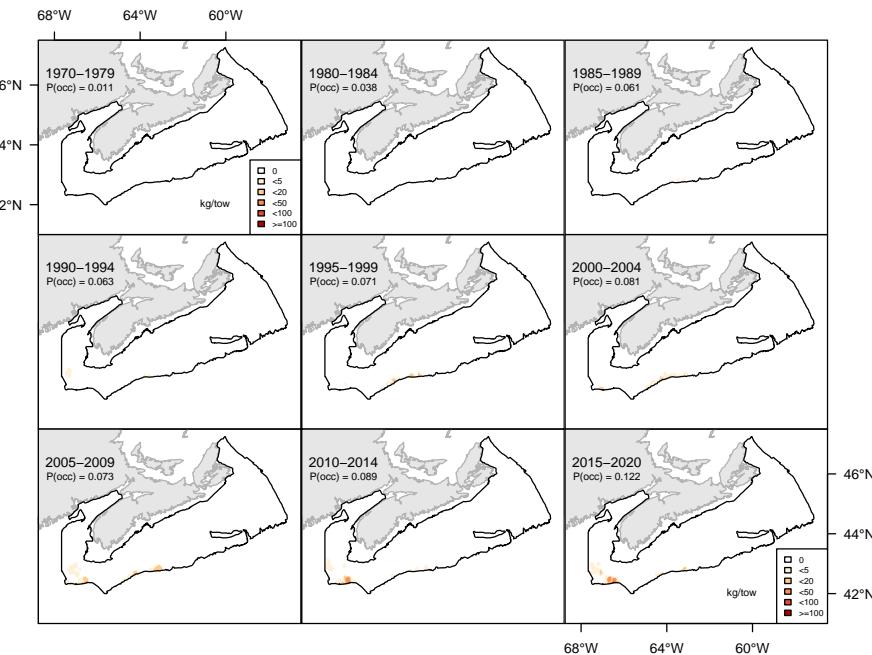


Figure 7.36A. Inverse distance weighted distribution of catch biomass (kg/tow) for Blackbelly rosefish.

944

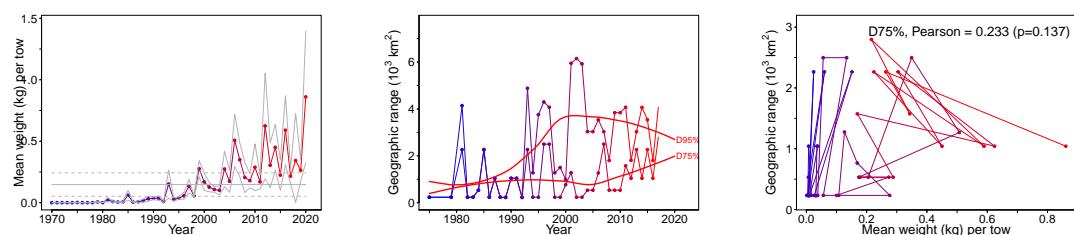


Figure 7.36B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Blackbelly rosefish.

945

### 7.37 Greater argentine (Grande argentine) - species code 160 (category LI)

946

Scientific name: [Argentina silus](#)

947

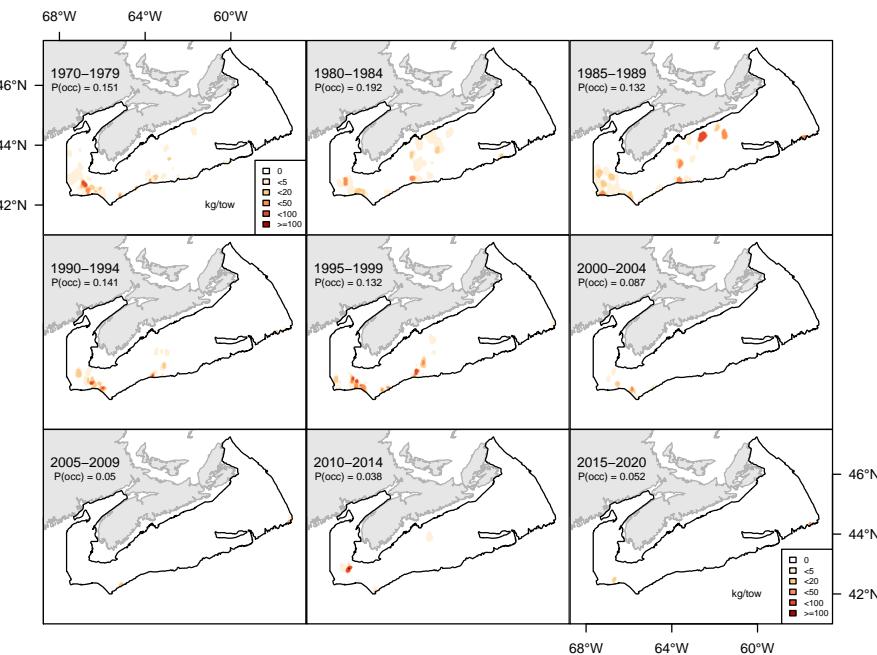


Figure 7.37A. Inverse distance weighted distribution of catch biomass (kg/tow) for Greater argentine.

948

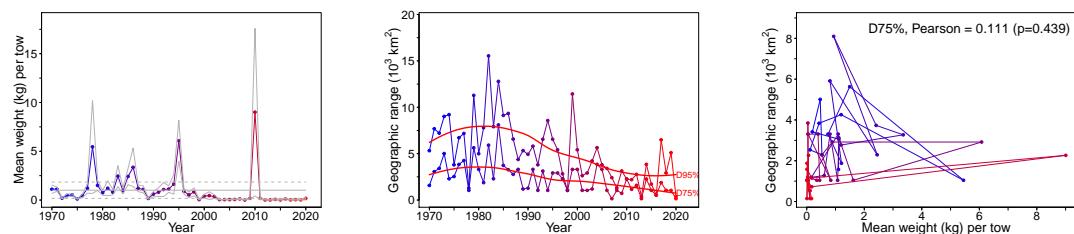


Figure 7.37B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greater argentine.

949      **7.38 Arctic hookear sculpin (*Hameçon neigeux*) - species code 306 (category LI)**

950      Scientific name: [Artediellus uncinatus](#)

951

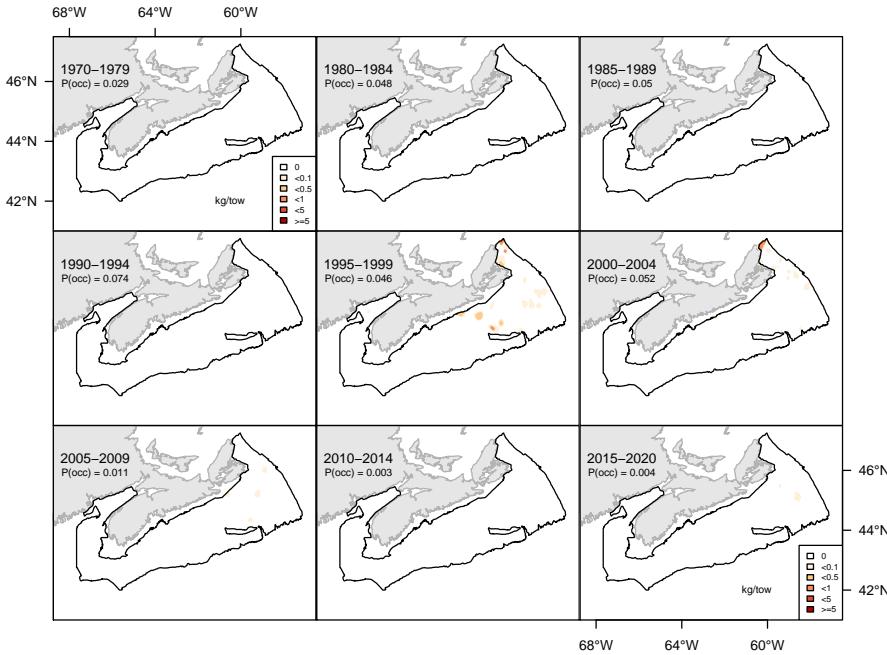


Figure 7.38A. Inverse distance weighted distribution of catch biomass (kg/tow) for Arctic hookear sculpin.

952

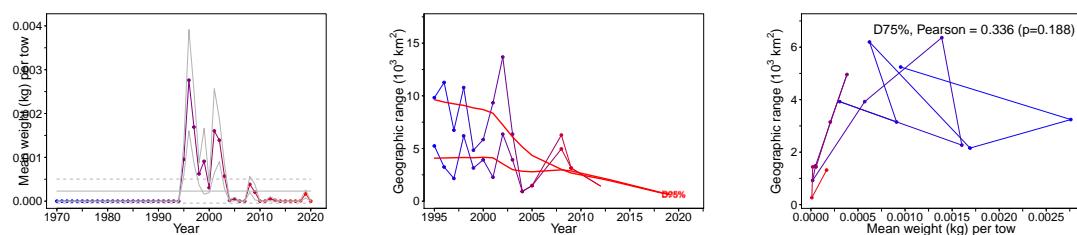


Figure 7.38B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic hookear sculpin.

953

### 7.39 Atlantic poacher (*Agone atlantique*) - species code 350 (category LI)

954

Scientific name: [Leptagonus decagonus](#)

955

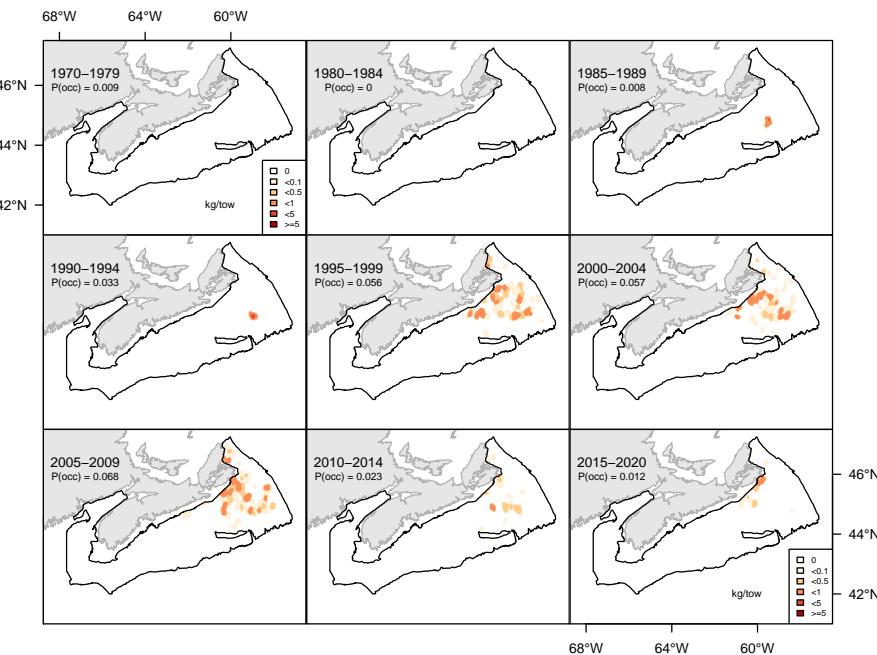


Figure 7.39A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic poacher.

956

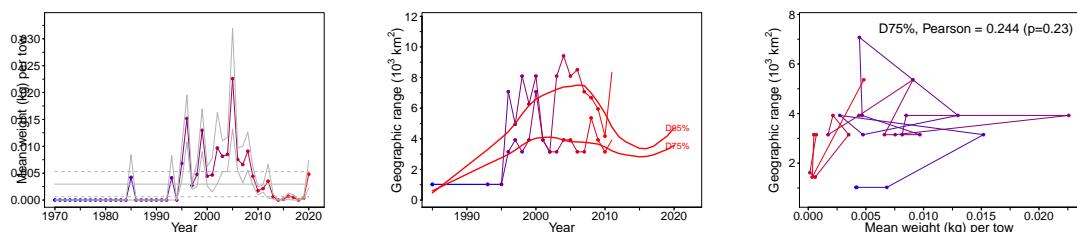


Figure 7.39B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic poacher.

957      **7.40 Marlin-spike grenadier (Grenadier du Grand Banc) - species code 410 (category**  
 958      **LI)**

959      Scientific name: [Nezumia bairdii](#)

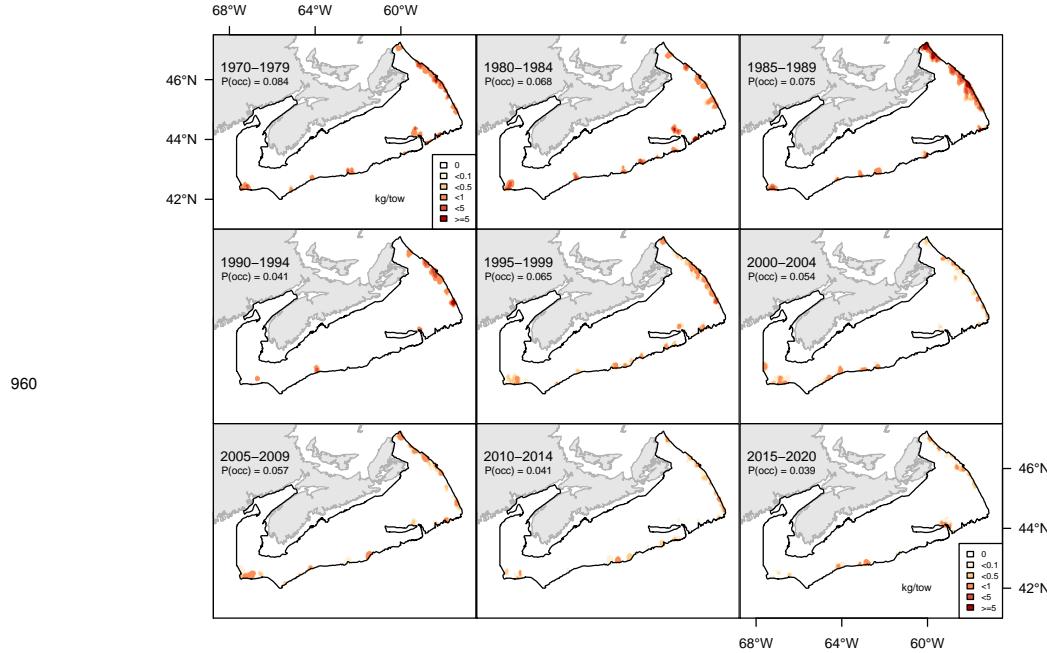


Figure 7.40A. Inverse distance weighted distribution of catch biomass (kg/tow) for Marlin-spike grenadier.

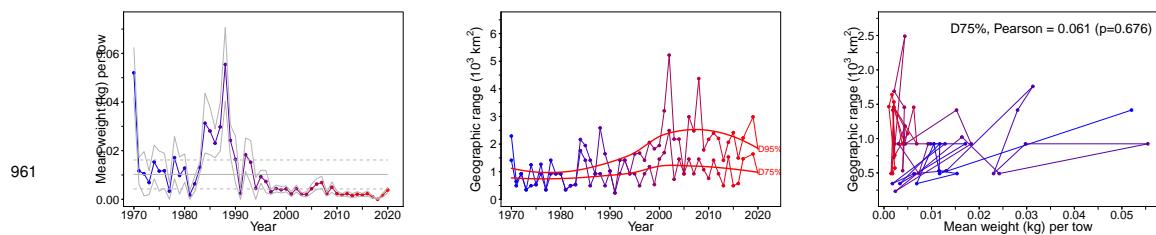


Figure 7.40B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Marlin-spike grenadier.

962

## 7.41 Lumpfish (Lompe) - species code 501 (category LI)

963

Scientific name: [Cyclopterus lumpus](#)

964

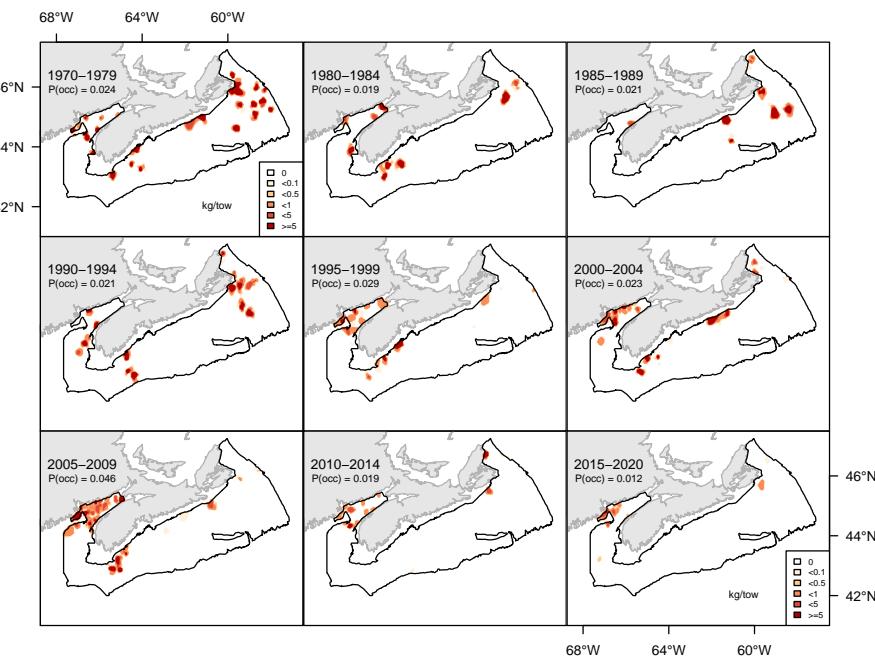


Figure 7.41A. Inverse distance weighted distribution of catch biomass (kg/tow) for Lumpfish.

965

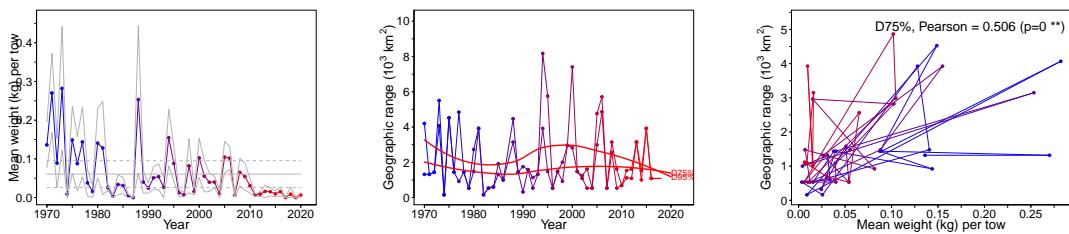


Figure 7.41B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Lumpfish.

966      **7.42 Atlantic spiny lumpsucker (Petite poule de mer atlantique) - species code 502**  
 967      (**category LI**)

968      Scientific name: [Eumicrotremus spinosus](#)

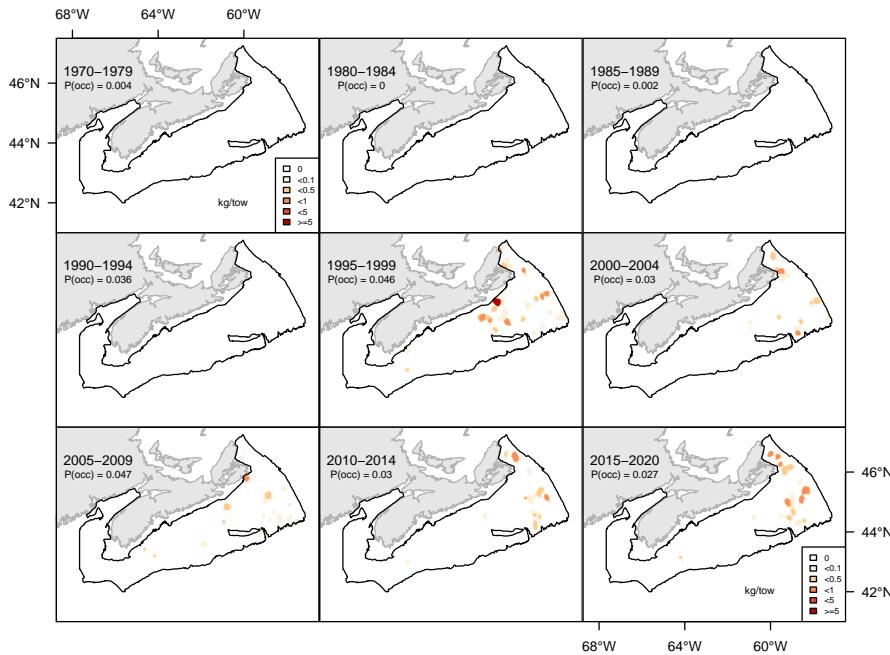


Figure 7.42A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic spiny lumpsucker.

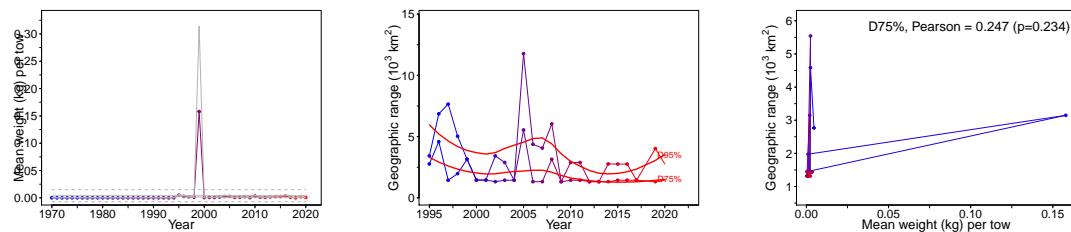


Figure 7.42B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic spiny lumpsucker.

971

## 7.43 Sand lance (Lançon) - species code 610 (category LI)

972

Scientific name: [Ammodytes dubius](#)

973

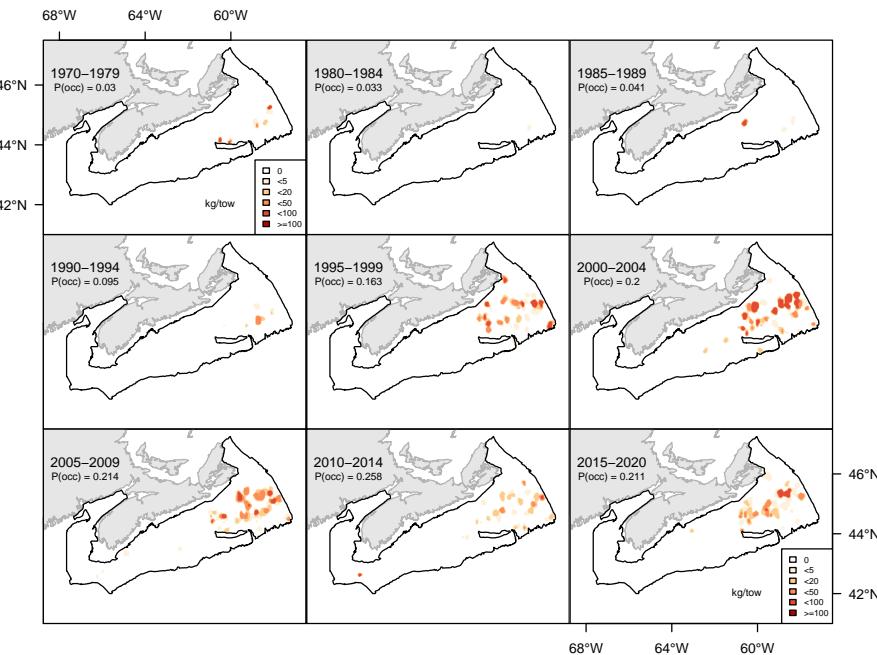


Figure 7.43A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sand lance.

974

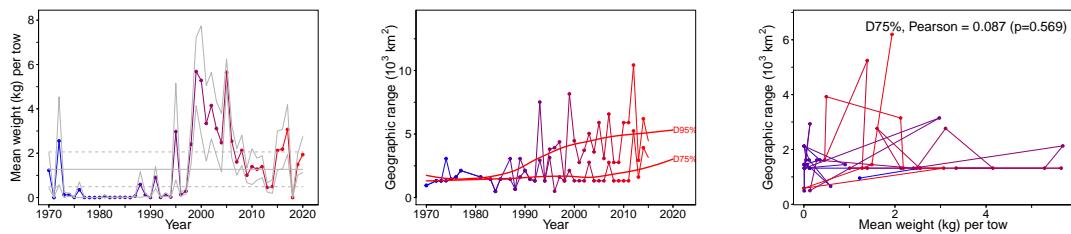


Figure 7.43B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sand lance.

975

#### 7.44 Snakeblenny (Lompénie-serpent) - species code 622 (category LI)

976

Scientific name: [Lumpenus lampretaeformis](#)

977

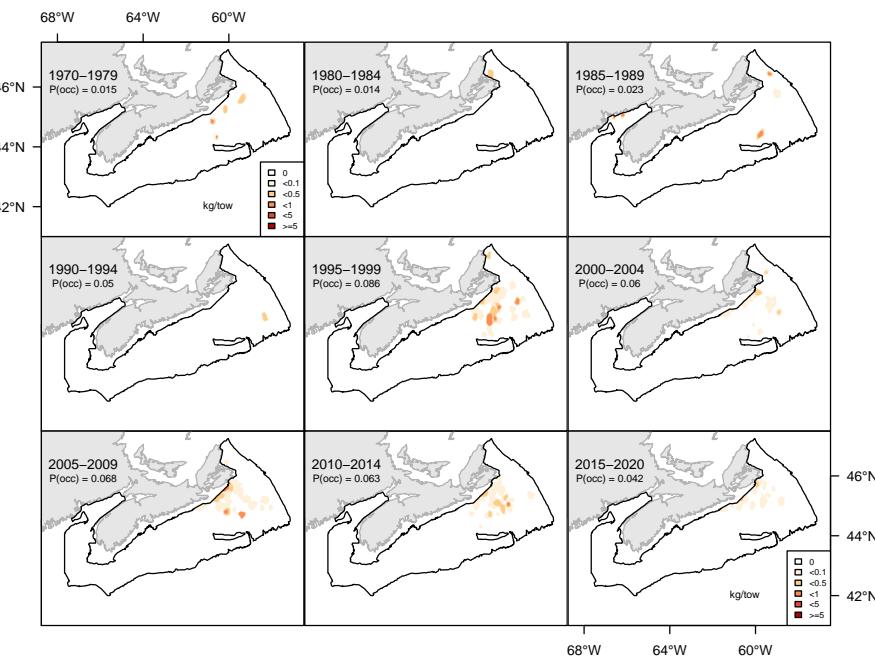


Figure 7.44A. Inverse distance weighted distribution of catch biomass (kg/tow) for Snakeblenny.

978

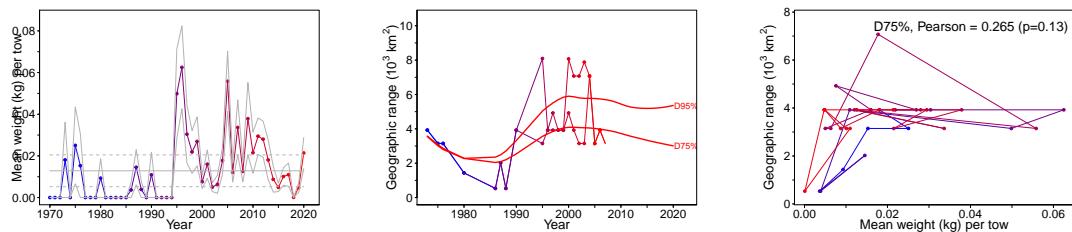


Figure 7.44B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Snakeblenny.

979

## 7.45 Daubed shanny (Lompénie tachetée) - species code 623 (category LI)

980

Scientific name: [Leptoclinus maculatus](#)

981

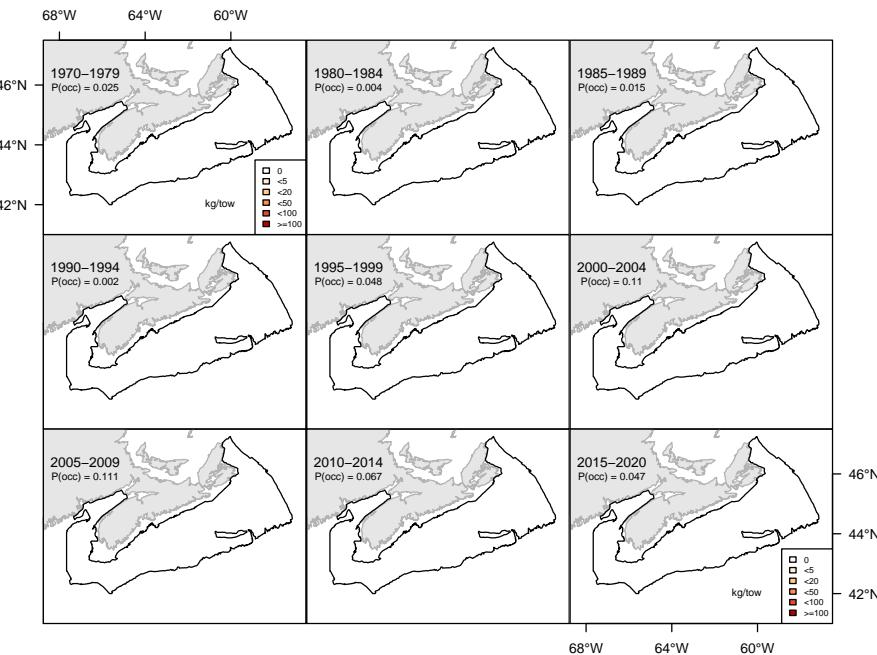


Figure 7.45A. Inverse distance weighted distribution of catch biomass (kg/tow) for Daubed shanny.

982

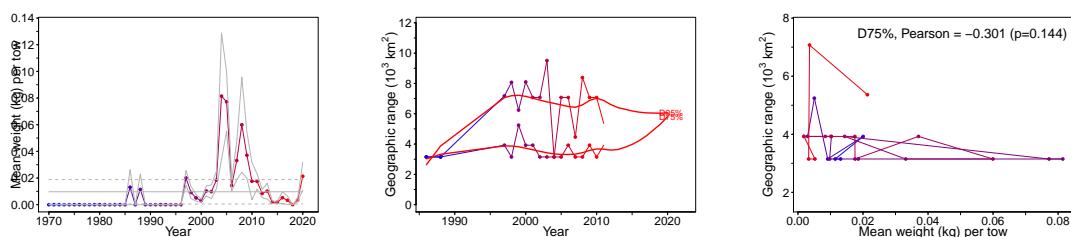


Figure 7.45B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Daubed shanny.

983

## 7.46 Vahl's eelpout (*Lycodes vahlii*) - species code 647 (category LI)

984

Scientific name: [Lycodes vahlii](#)

985

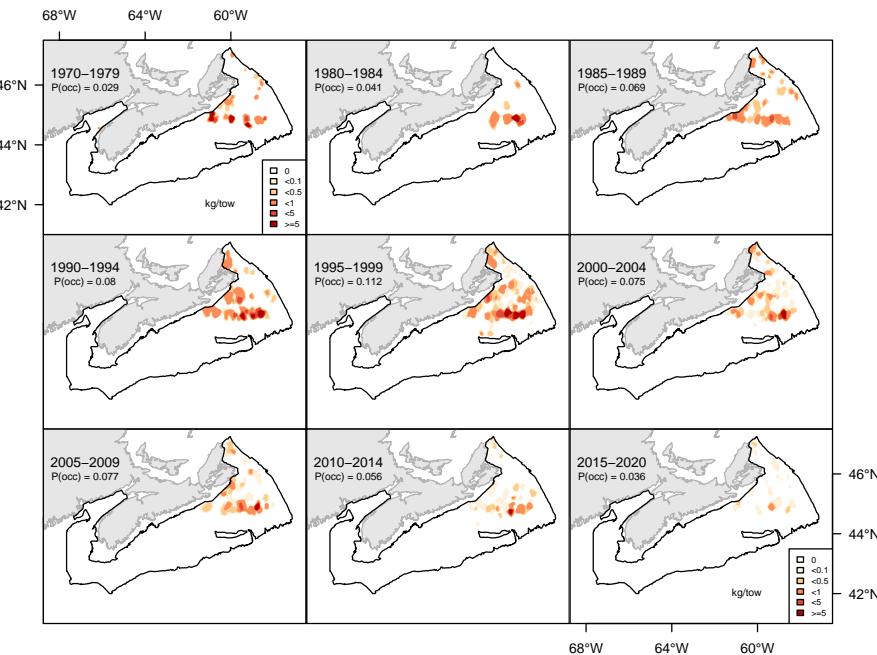


Figure 7.46A. Inverse distance weighted distribution of catch biomass (kg/tow) for Vahl's eelpout.

986

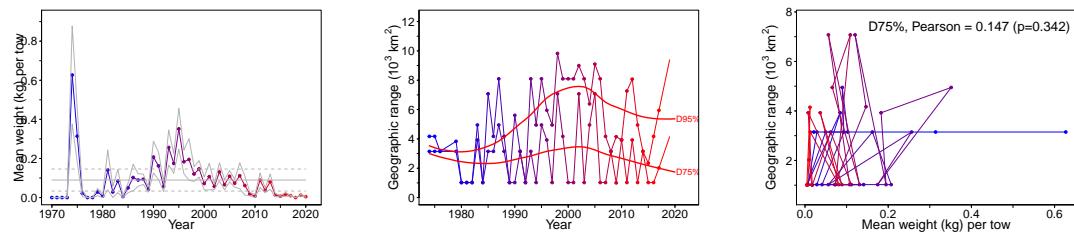


Figure 7.46B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Vahl's eelpout.

987

## 7.47 Atlantic butterfish (*Stromaté fossette*) - species code 701 (category LI)

988

Scientific name: [Peprilus triacanthus](#)

989

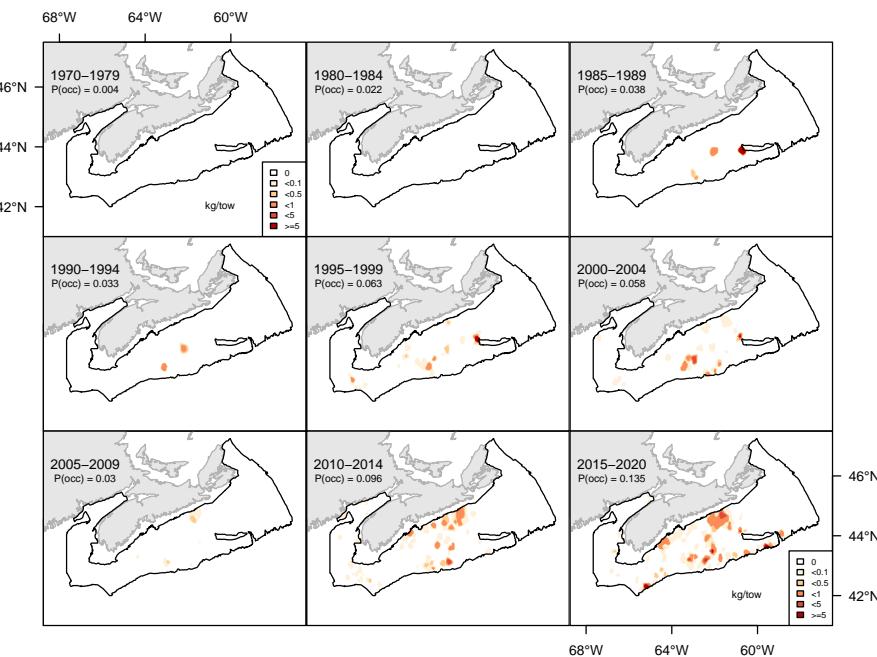


Figure 7.47A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic butterfish.

990

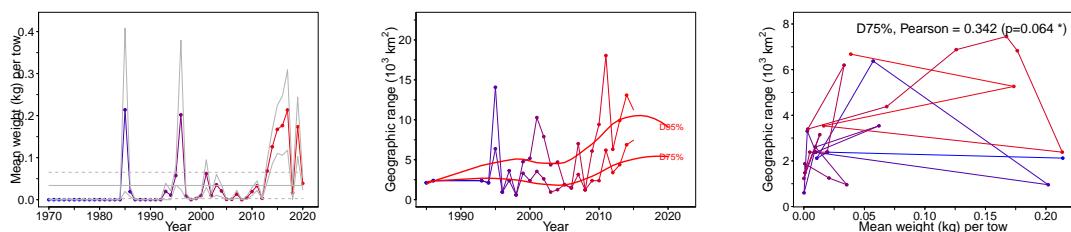


Figure 7.47B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic butterfish.

991      **7.48 Atlantic hookear sculpin (*Hameçon atlantique*) - species code 880 (category LI)**

992      Scientific name: [Artediellus atlanticus](#)

993

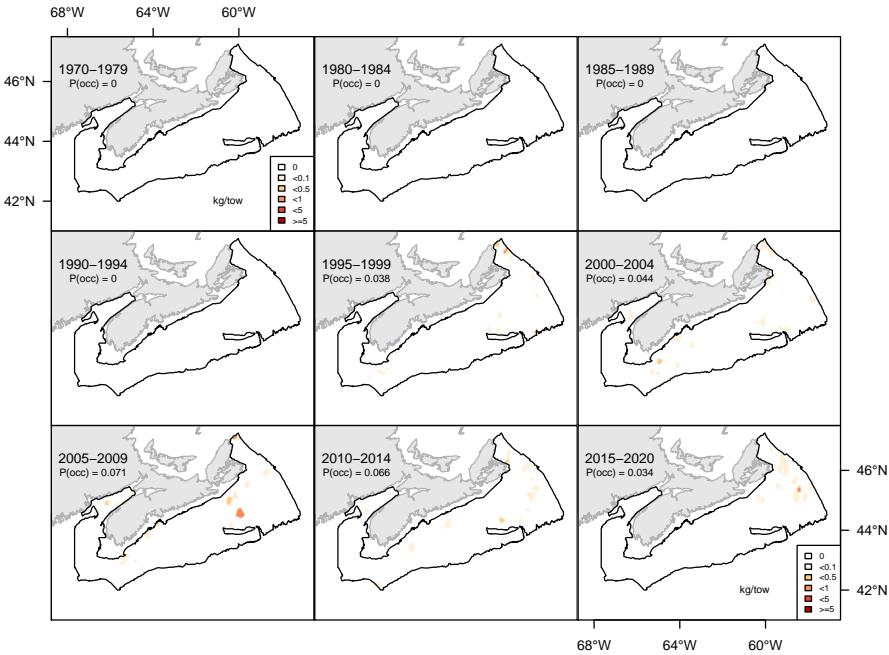


Figure 7.48A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic hookear sculpin.

994

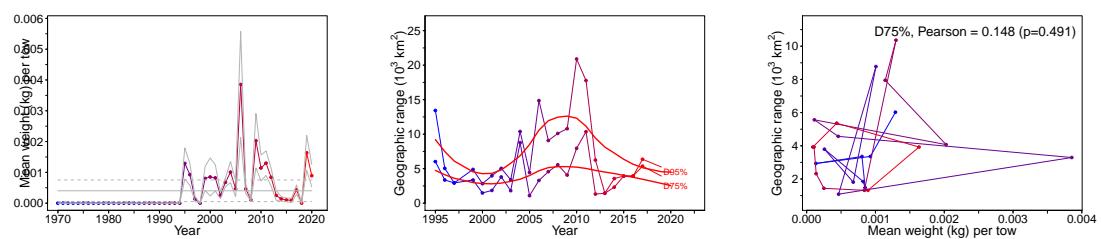


Figure 7.48B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hookear sculpin.

995      **7.49 Barndoor skate (Grande raie) - species code 200 (category LI)**

996      Scientific name: *Dipturus laevis*

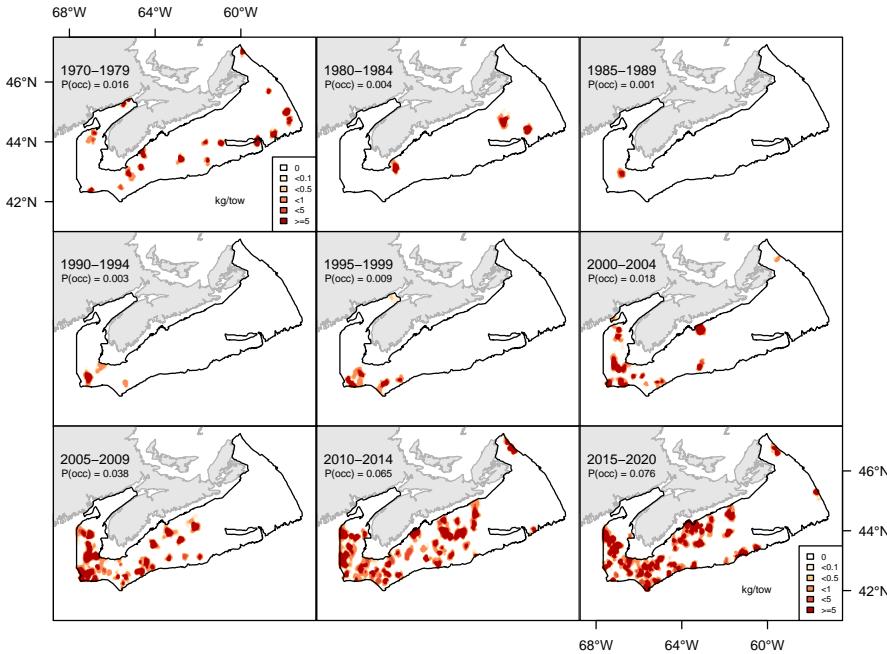


Figure 7.49A. Inverse distance weighted distribution of catch biomass (kg/tow) for Barndoor skate.

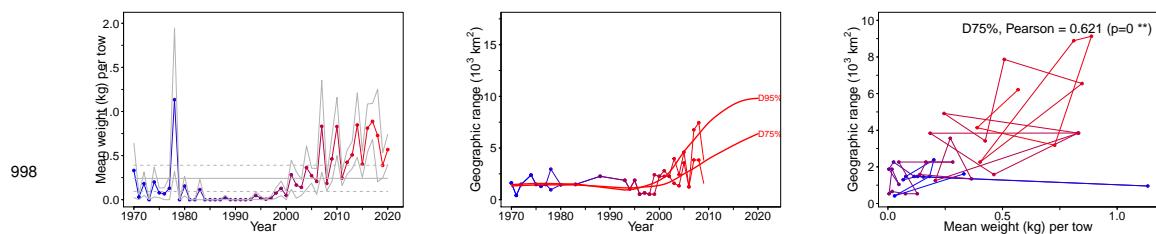


Figure 7.49B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Barndoor skate.

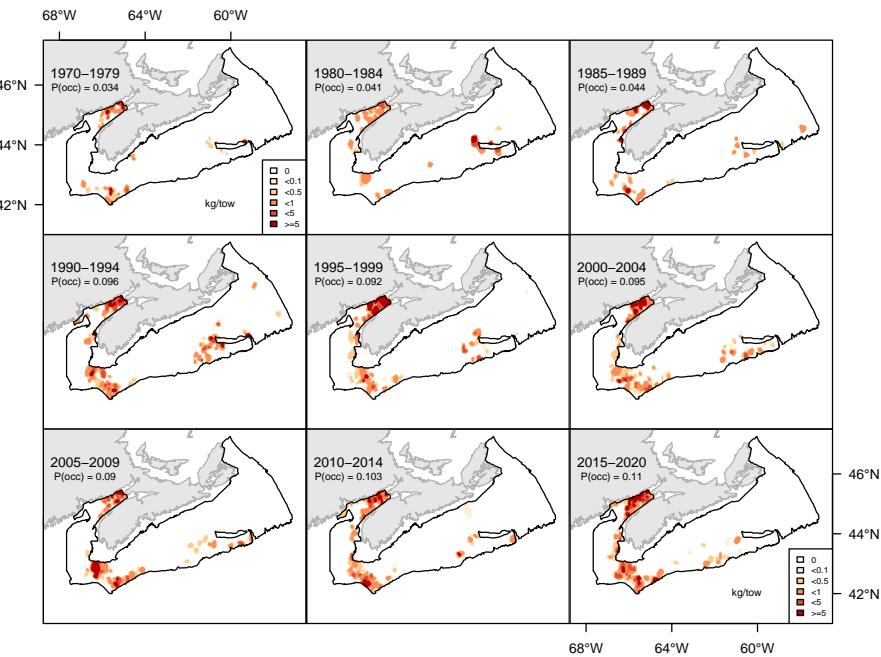
999

## 7.50 Little skate (Raie hérisson) - species code 203 (category LI)

1000

Scientific name: [Leucoraja erinacea](#)

1001



1002

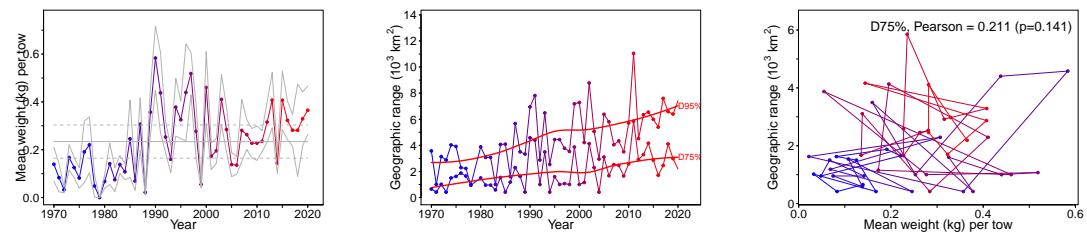


Figure 7.50B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Little skate.

1003

### 7.51 Northern prawn (Crevette nordique) - species code 2211 (category SF)

1004

Scientific name: [Pandalus borealis](#)

1005

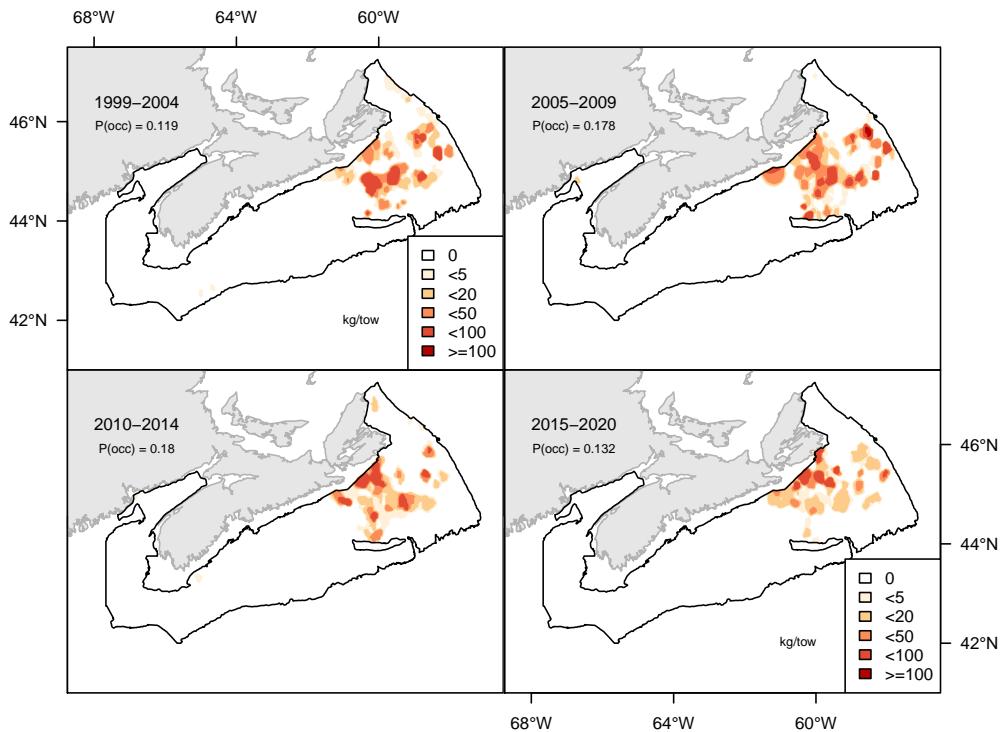


Figure 7.51A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern prawn.

1006

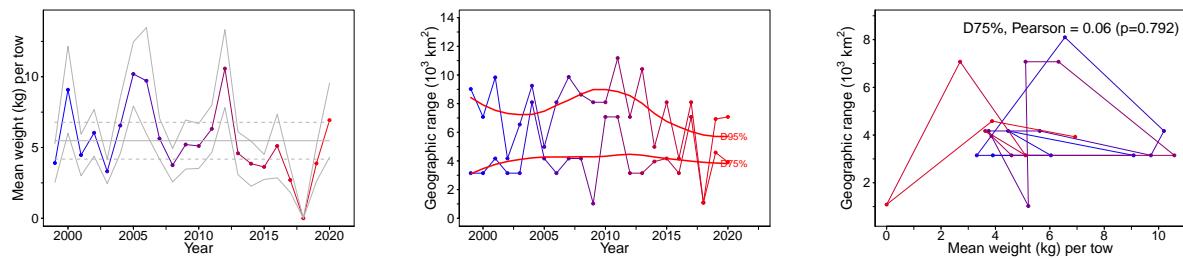


Figure 7.51B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern prawn.

1007

## 7.52 Jonah crab (*Tourteau jona*) - species code 2511 (category SF)

1008

Scientific name: [Cancer borealis](#)

1009

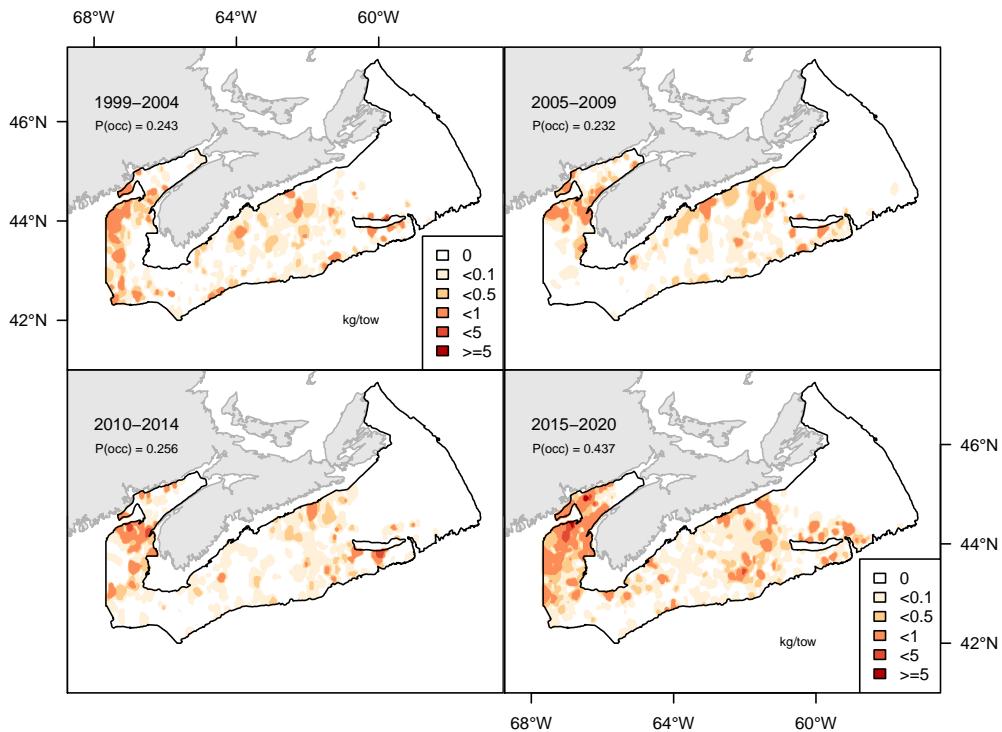


Figure 7.52A. Inverse distance weighted distribution of catch biomass (kg/tow) for Jonah crab.

1010

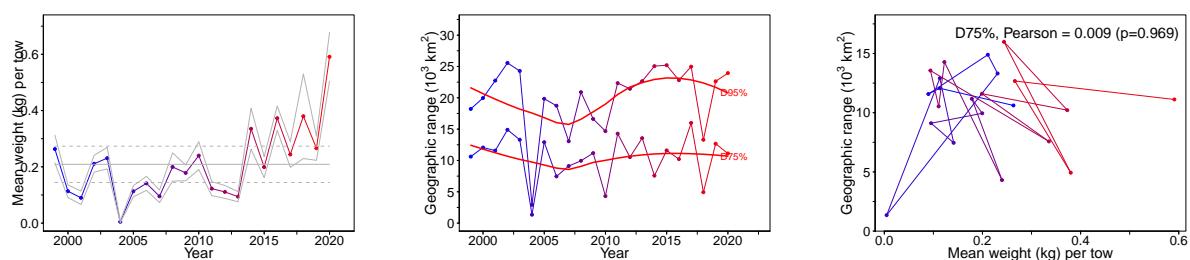


Figure 7.52B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Jonah crab.

1011

### 7.53 Atlantic rock crab (Tourteau poïnclos) - species code 2513 (category SF)

1012

Scientific name: [Cancer irroratus](#)

1013

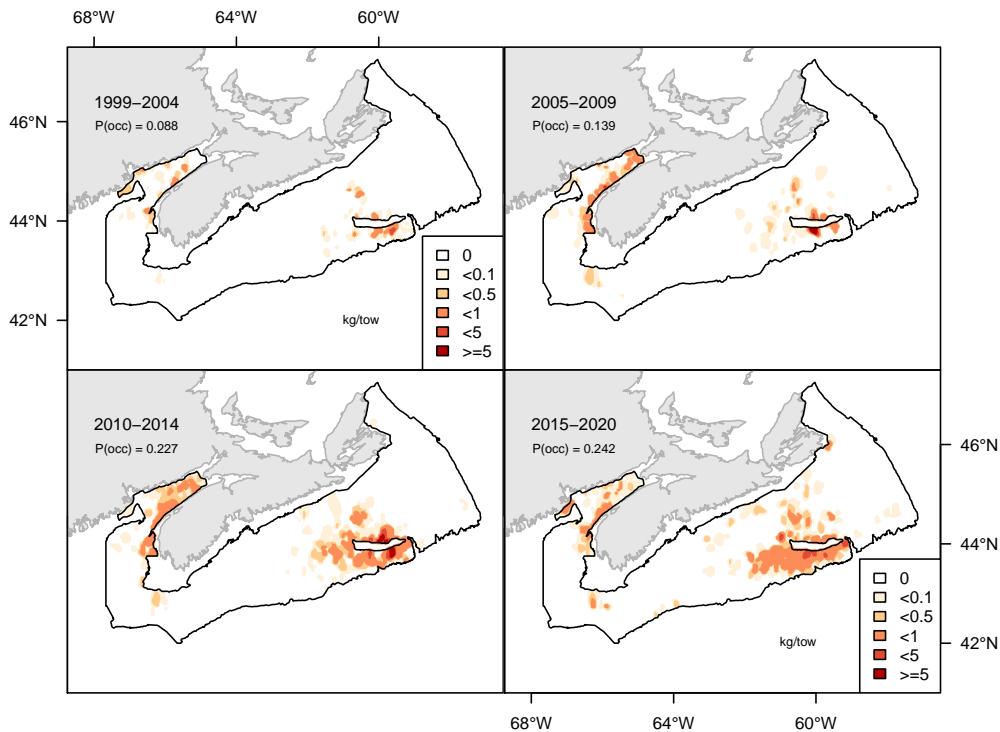


Figure 7.53A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic rock crab.

1014

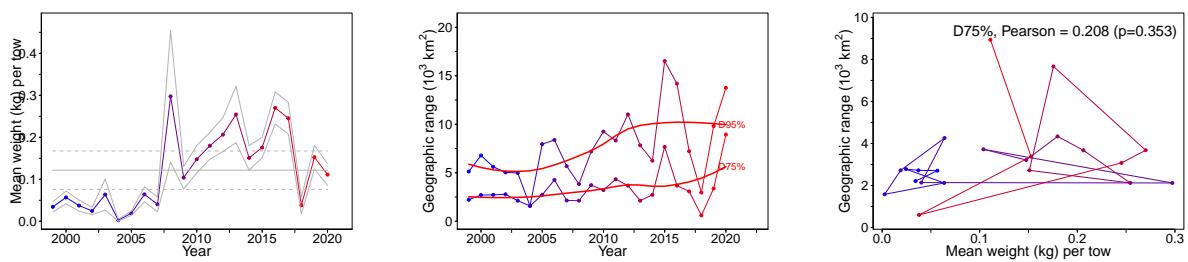


Figure 7.53B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic rock crab.

1015      **7.54 Arctic lyre crab (*Crabe Hyas coarctatus*) - species code 2521 (category SF)**

1016      Scientific name: [Hyas coarctatus](#)

1017

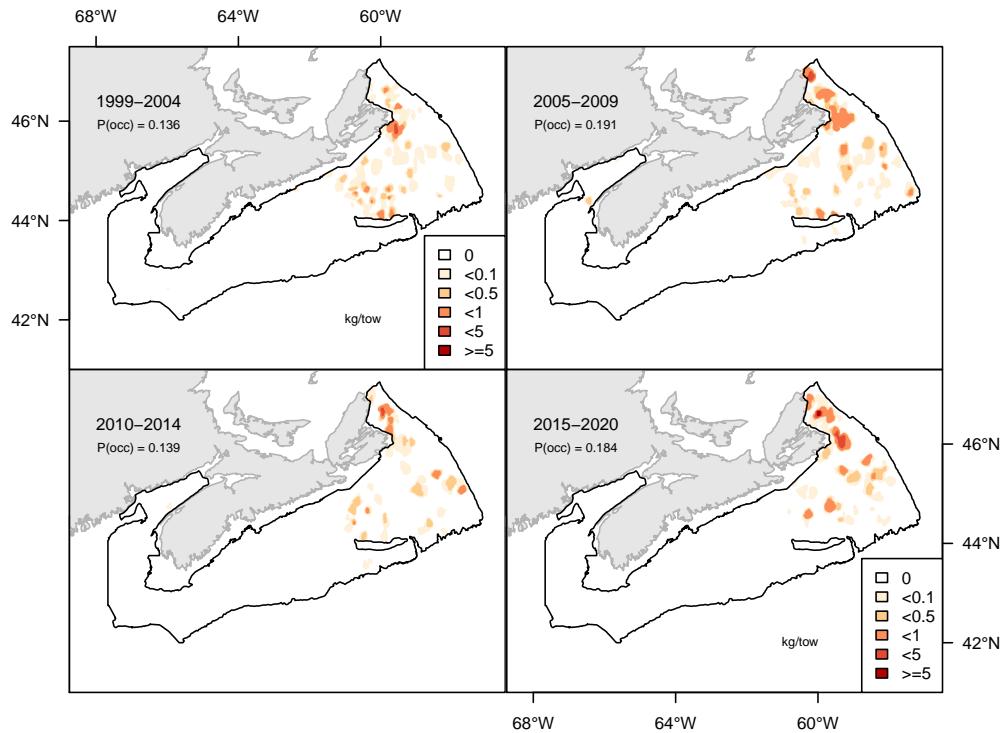


Figure 7.54A. Inverse distance weighted distribution of catch biomass (kg/tow) for Arctic lyre crab.

1018

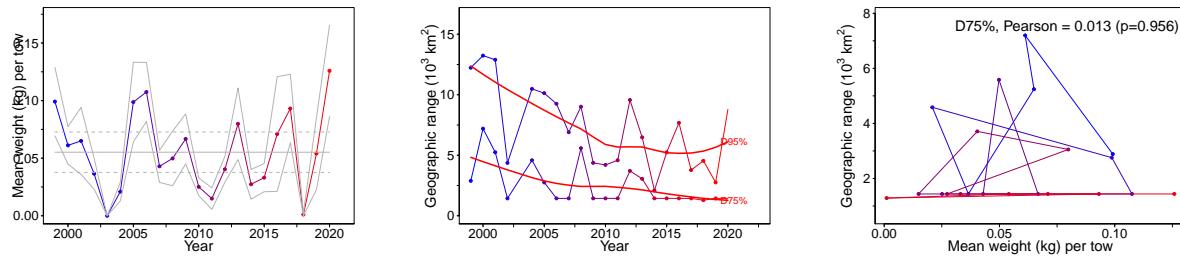


Figure 7.54B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic lyre crab.

1019

## 7.55 Atlantic king crab (Crabe épineux du nord) - species code 2523 (category SF)

1020

Scientific name: [Lithodes maja](#)

1021

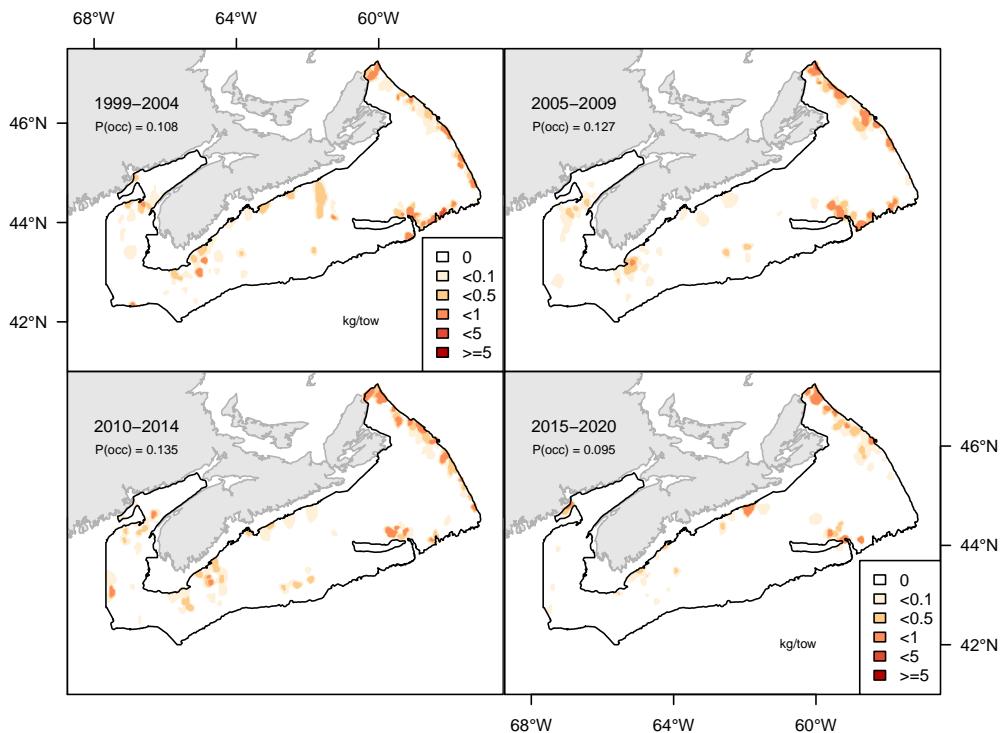


Figure 7.55A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic king crab.

1022

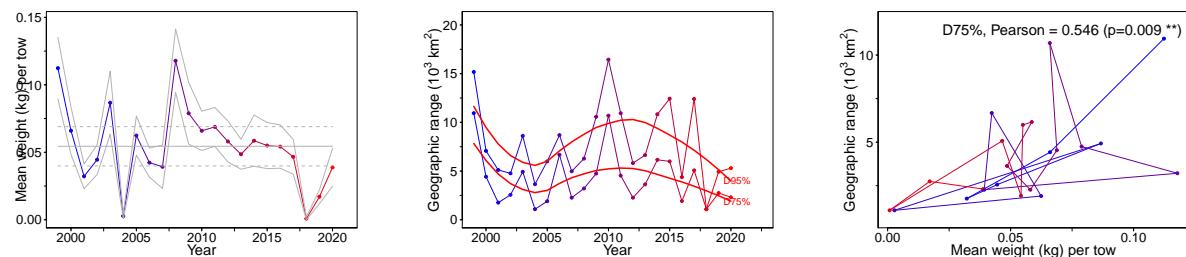


Figure 7.55B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic king crab.

1023

## 7.56 Queen crab (Crabe des neiges) - species code 2526 (category SF)

1024

Scientific name: [Chionoecetes opilio](#)

1025

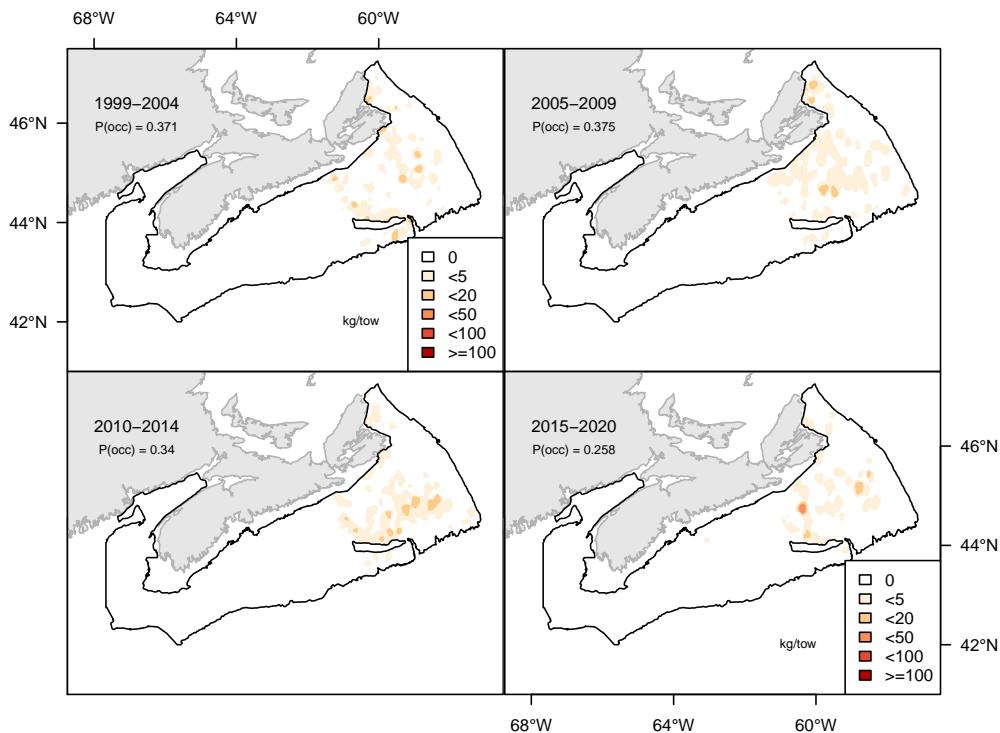


Figure 7.56A. Inverse distance weighted distribution of catch biomass (kg/tow) for Queen crab.

1026

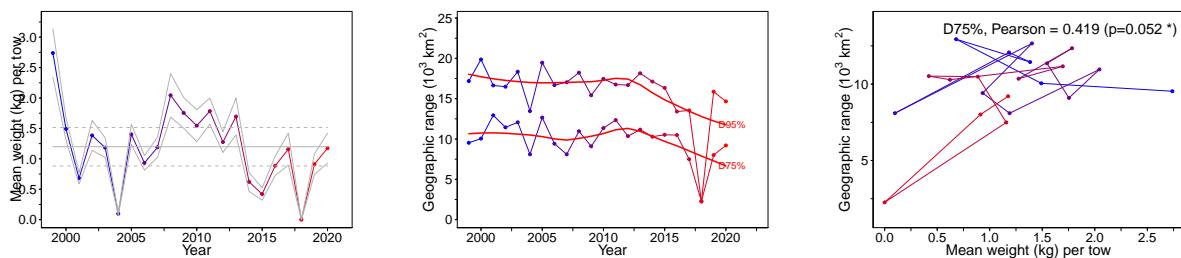


Figure 7.56B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Queen crab.

1027

## 7.57 Great spider crab (Crabe lyre araignée) - species code 2527 (category SF)

1028

Scientific name: [Hyas araneus](#)

1029

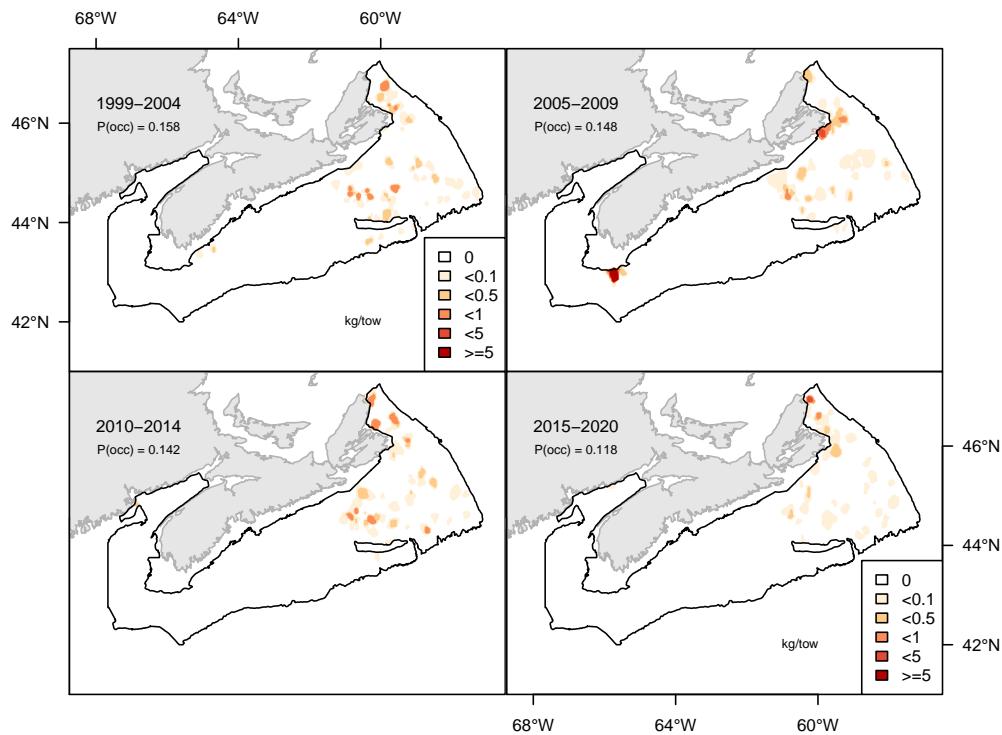


Figure 7.57A. Inverse distance weighted distribution of catch biomass (kg/tow) for Great spider crab.

1030

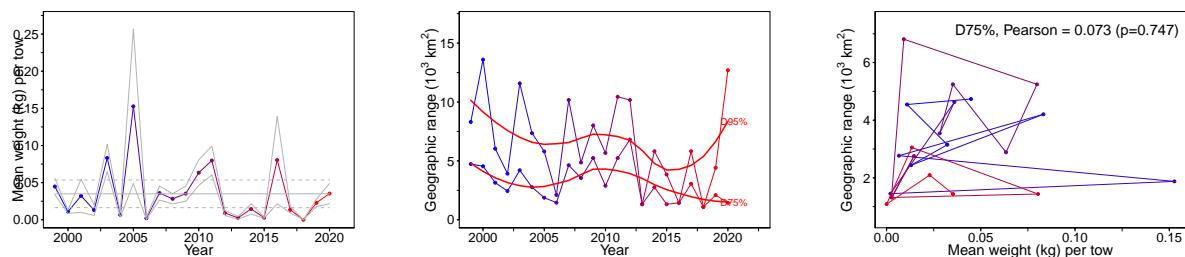


Figure 7.57B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Great spider crab.

1031

## 7.58 American lobster (Homard américain) - species code 2550 (category SF)

1032

Scientific name: [Homarus americanus](#)

1033

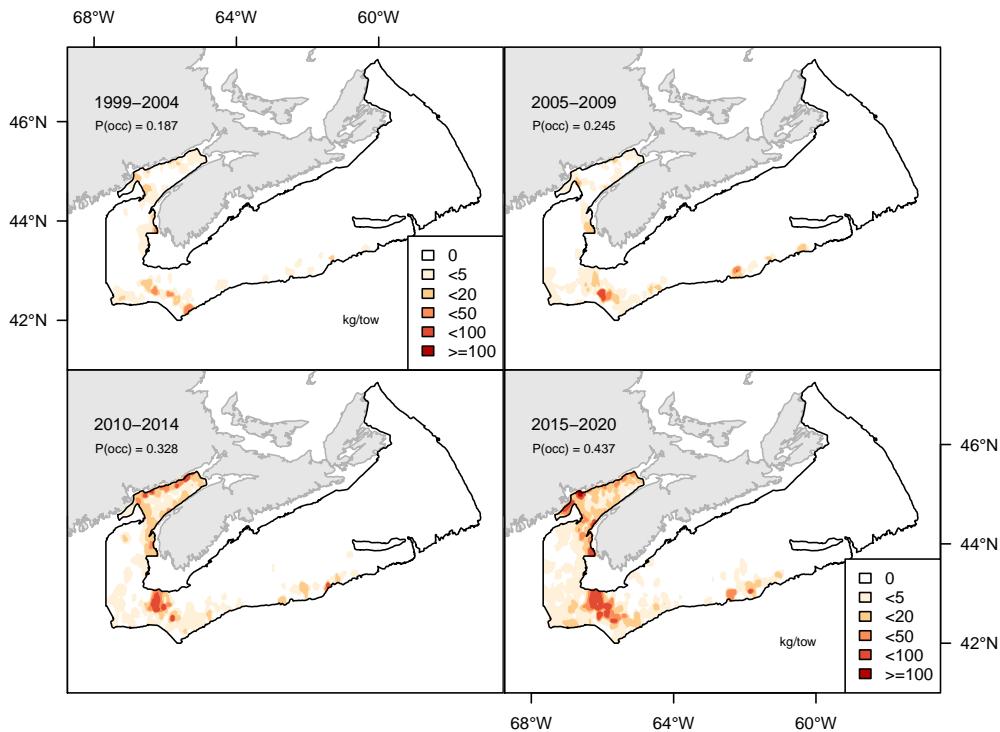


Figure 7.58A. Inverse distance weighted distribution of catch biomass (kg/tow) for American lobster.

1034

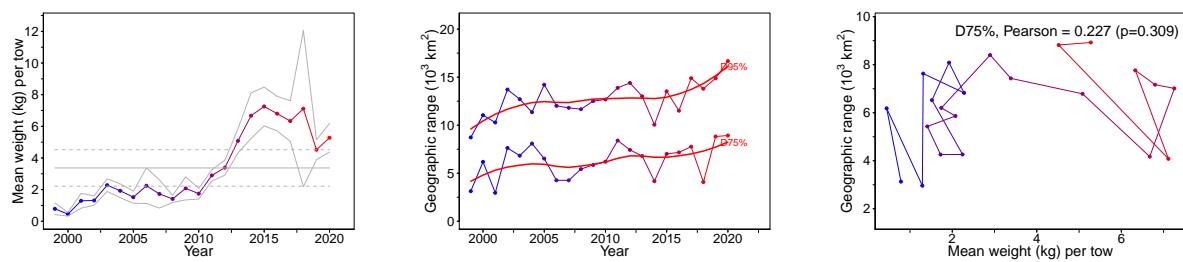


Figure 7.58B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American lobster.

1035      **7.59 Sea lamprey (*Lamproie marine*) - species code 240 (category LR)**

1036      Scientific name: [Petromyzon marinus](#)

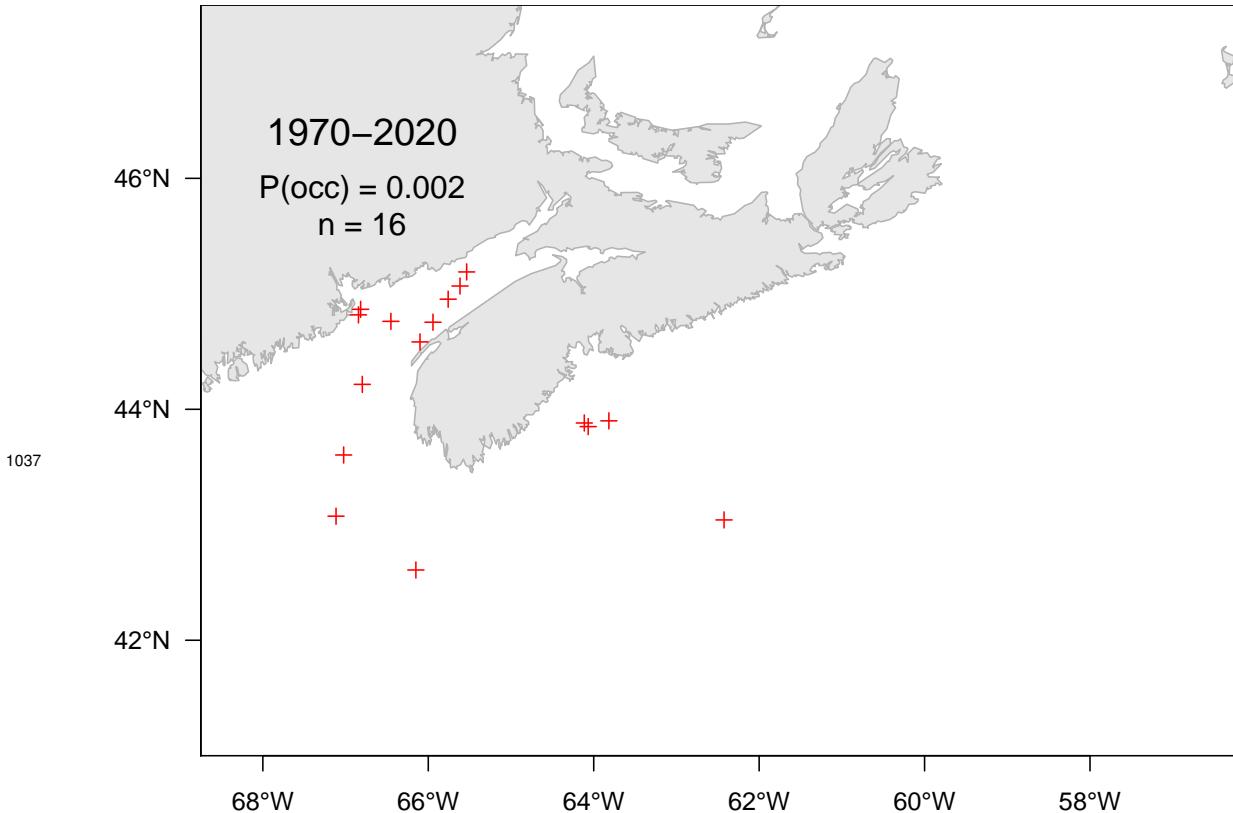


Figure 7.59A. Catch distribution for Sea lamprey.

1038

## 7.60 Atlantic tomcod (*Poulamon atlantique*) - species code 17 (category LR)

1039

Scientific name: [Microgadus tomcod](#)

1040

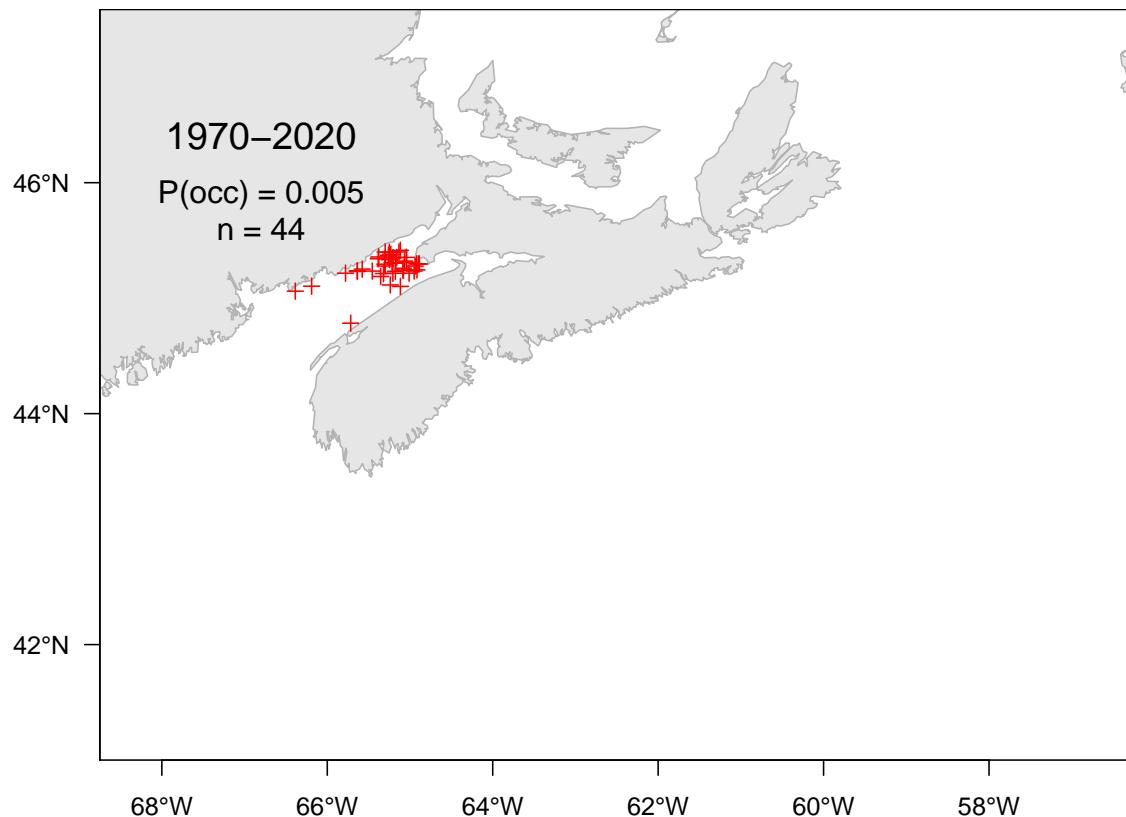


Figure 7.60A. Catch distribution for Atlantic tomcod.

1041

## 7.61 Offshore silver hake (Merlu argenté du large) - species code 19 (category LR)

1042

Scientific name: [Merluccius albidus](#)

1043

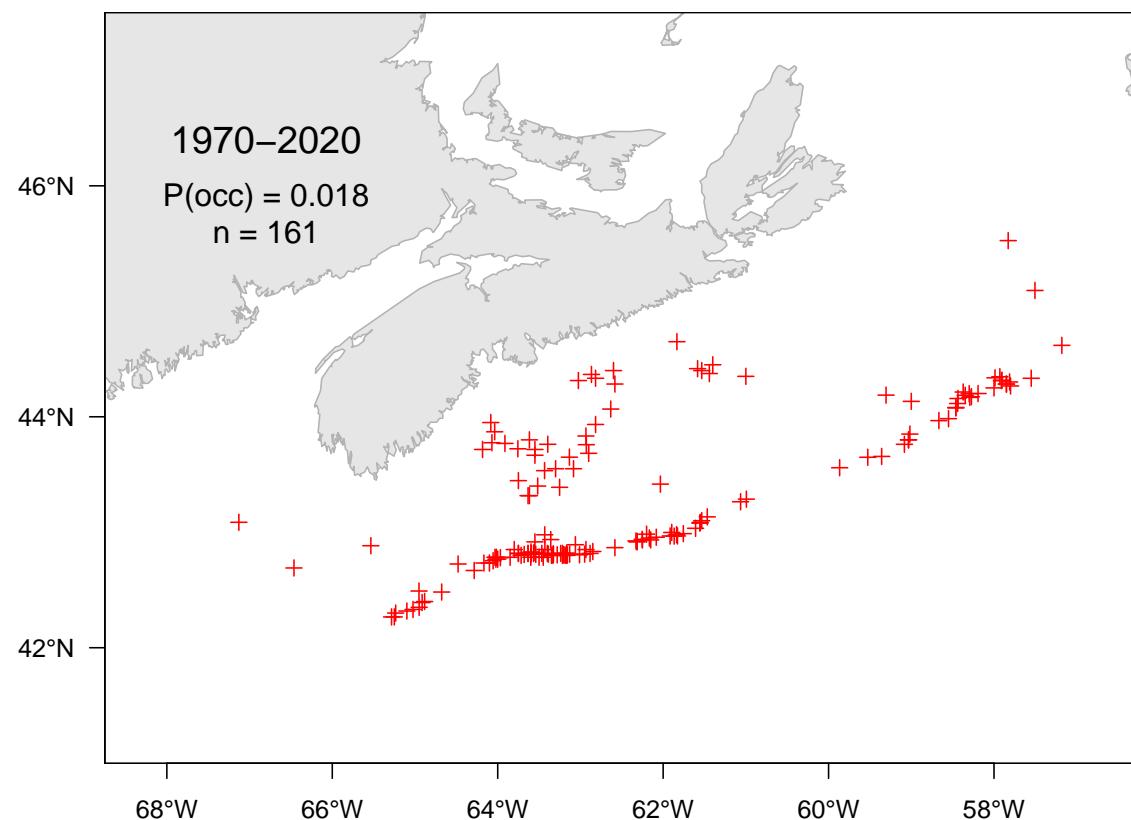


Figure 7.61A. Catch distribution for Offshore silver hake.

1044

## 7.62 Spotted wolffish (Loup tacheté) - species code 51 (category LR)

1045

Scientific name: [Anarhichas minor](#)

1046

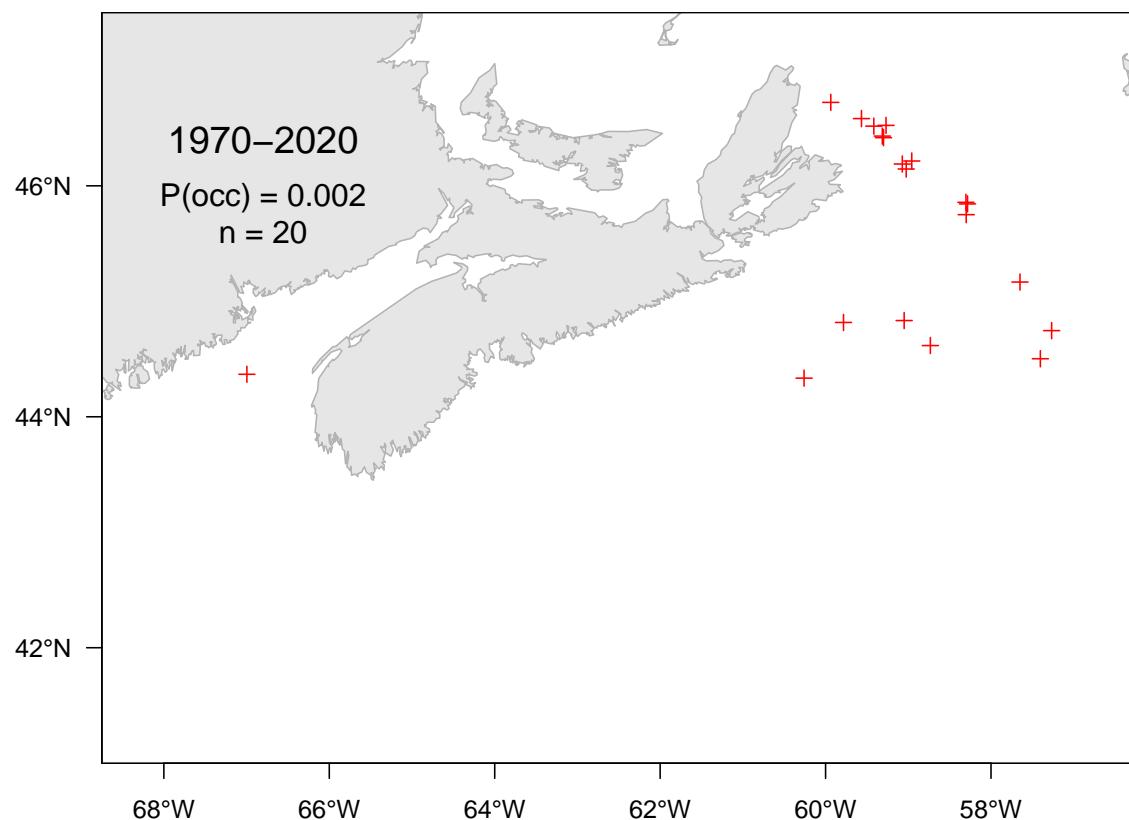


Figure 7.62A. Catch distribution for Spotted wolffish.

1047

### 7.63 Northern wolffish (Loup à tête large) - species code 52 (category LR)

1048

Scientific name: [Anarhichas denticulatus](#)

1049

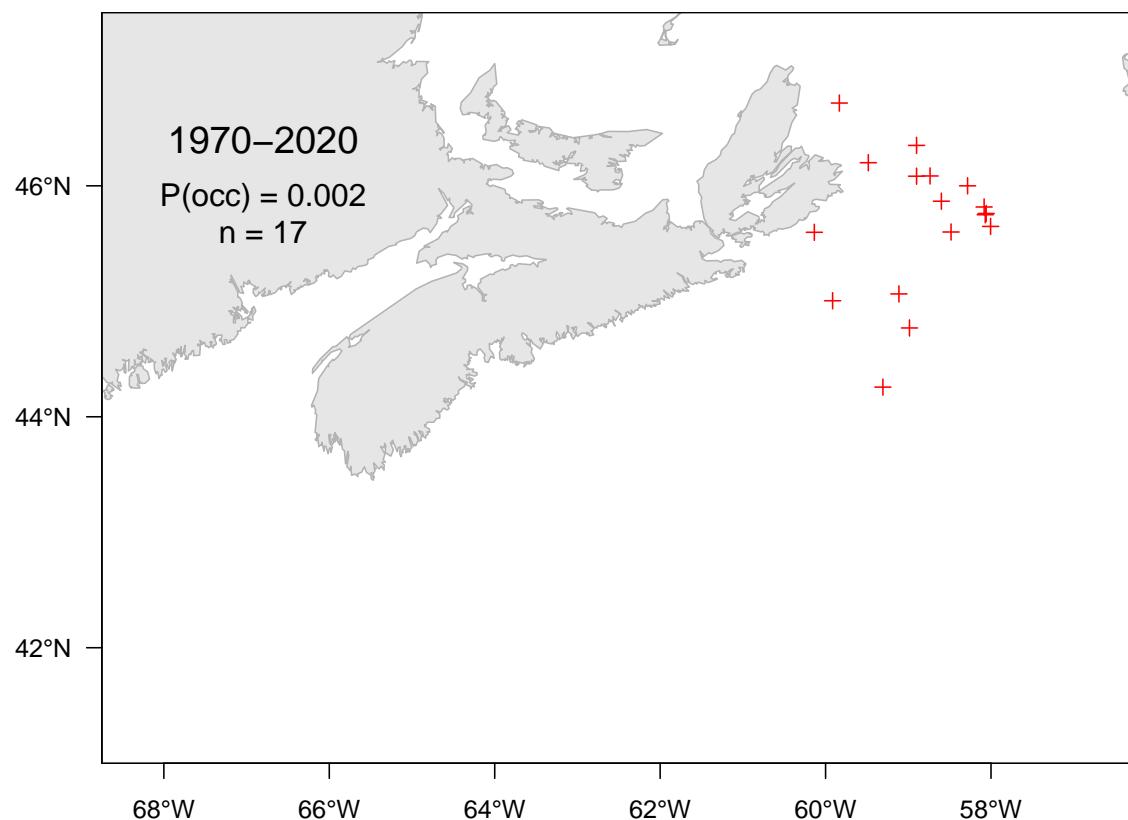


Figure 7.63A. Catch distribution for Northern wolffish.

1050

## 7.64 Rainbow smelt (Éperlan arc-en-ciel) - species code 63 (category LR)

1051

Scientific name: [Osmerus mordax](#)

1052

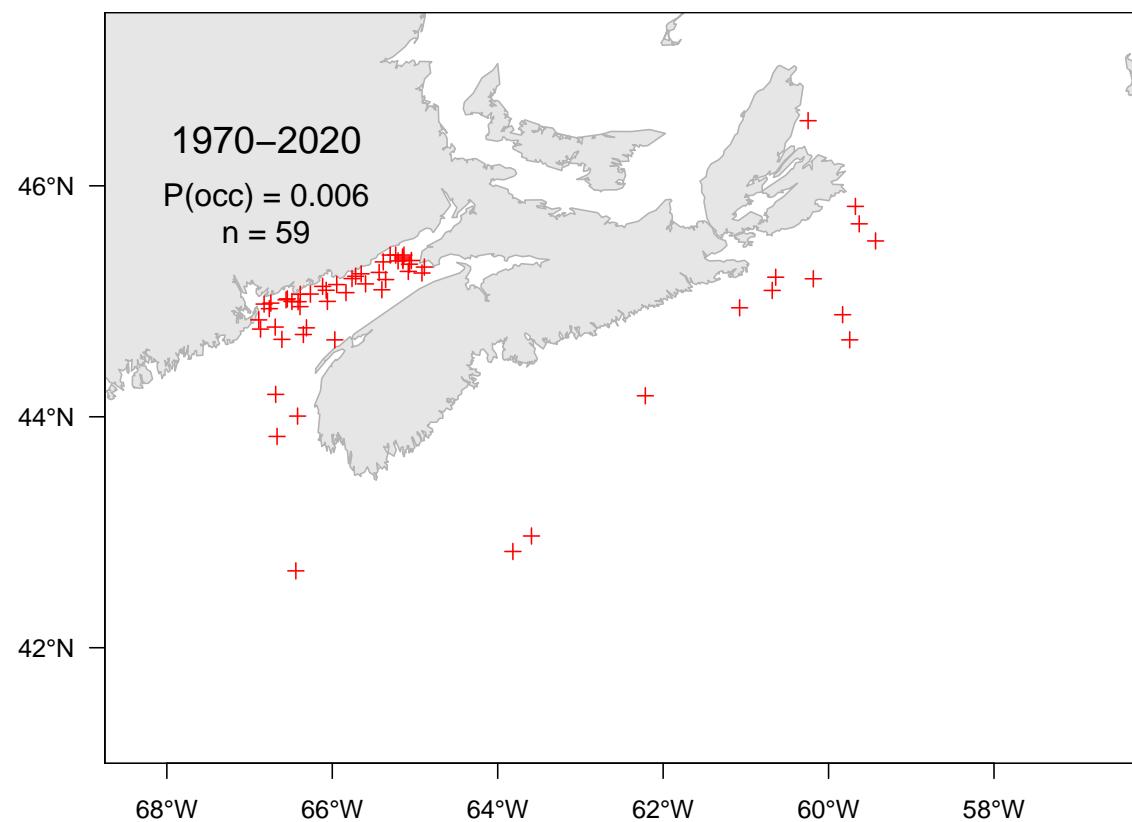


Figure 7.64A. Catch distribution for Rainbow smelt.

1053

### 7.65 Cunner (Tanche-tautogue) - species code 122 (category LR)

1054

Scientific name: [Tautogolabrus adspersus](#)

1055

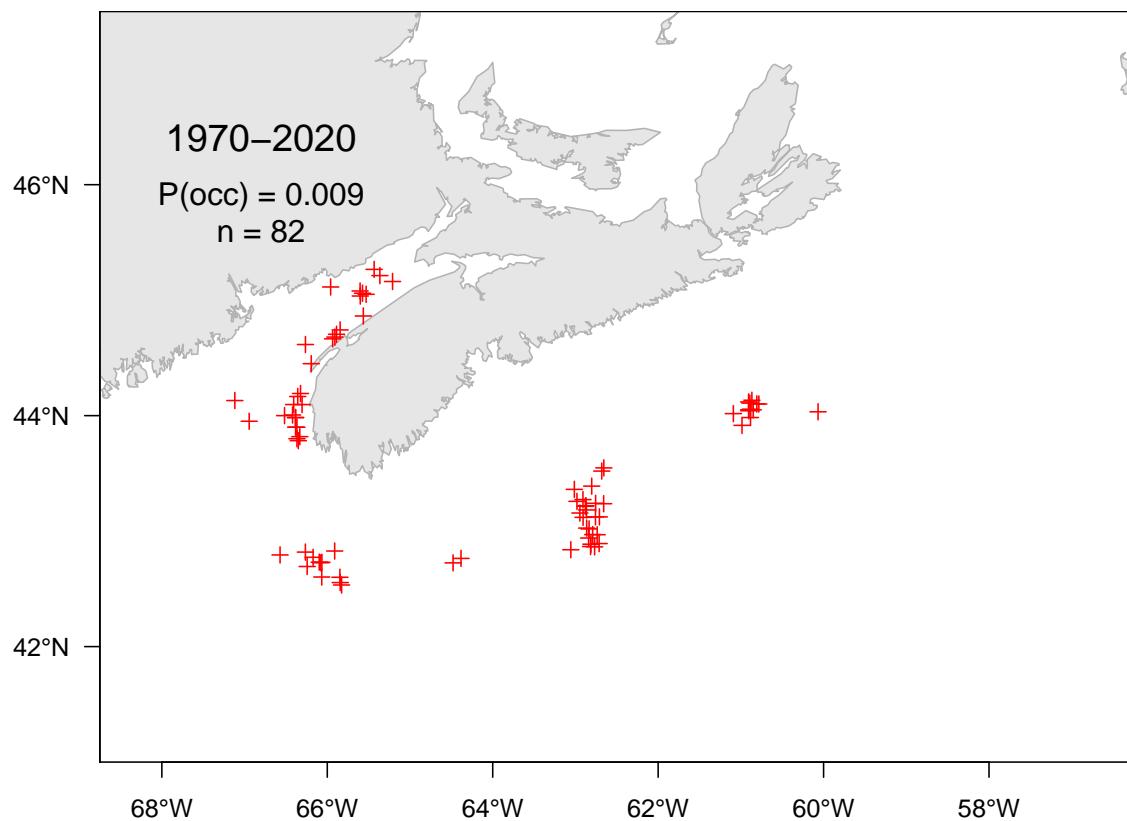


Figure 7.65A. Catch distribution for Cunner.

1056

## 7.66 Fourspot flounder (Cardeau à quatre ocelles) - species code 142 (category LR)

1057

Scientific name: [Hippoglossina oblonga](#)

1058

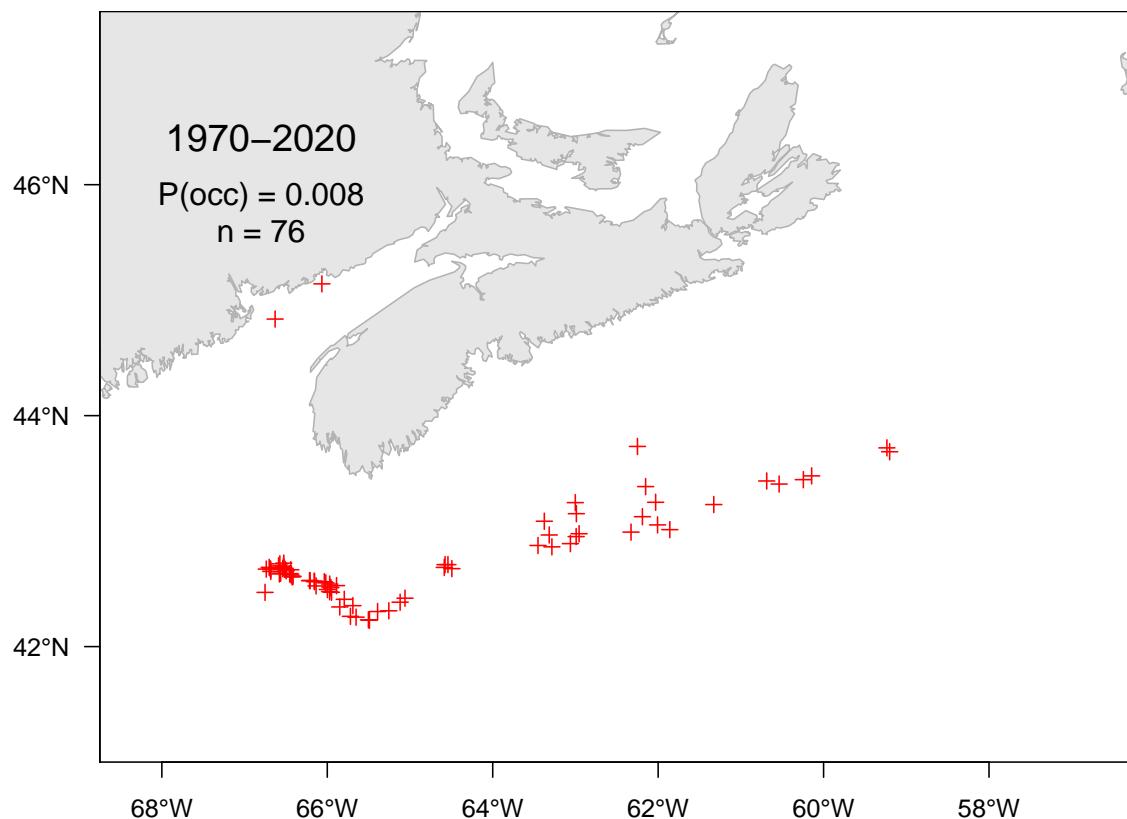


Figure 7.66A. Catch distribution for Fourspot flounder.

1059

### 7.67 Windowpane flounder (Turbot de sable) - species code 143 (category LR)

1060

Scientific name: [Scophthalmus aquosus](#)

1061

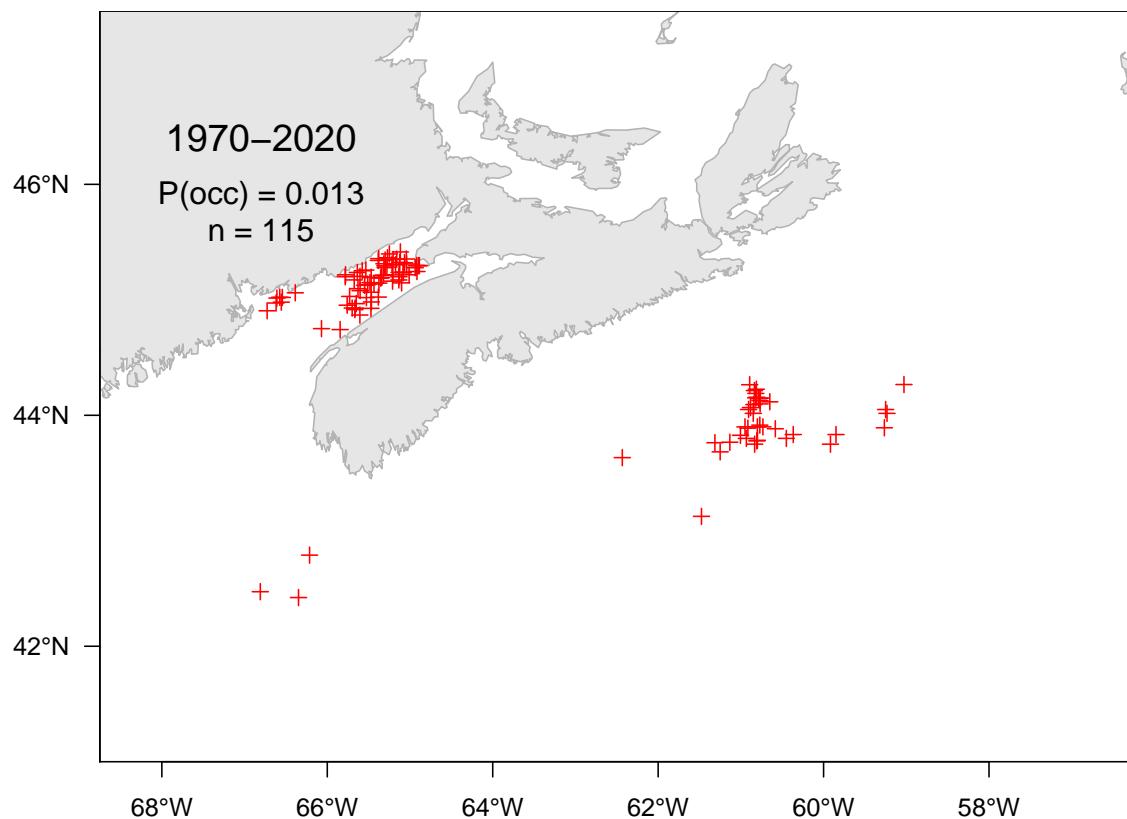


Figure 7.67A. Catch distribution for Windowpane flounder.

1062

## 7.68 Longnose greeneye (Oeil-vert à long nez) - species code 149 (category LR)

1063

Scientific name: [Parasudis triculenta](#)

1064

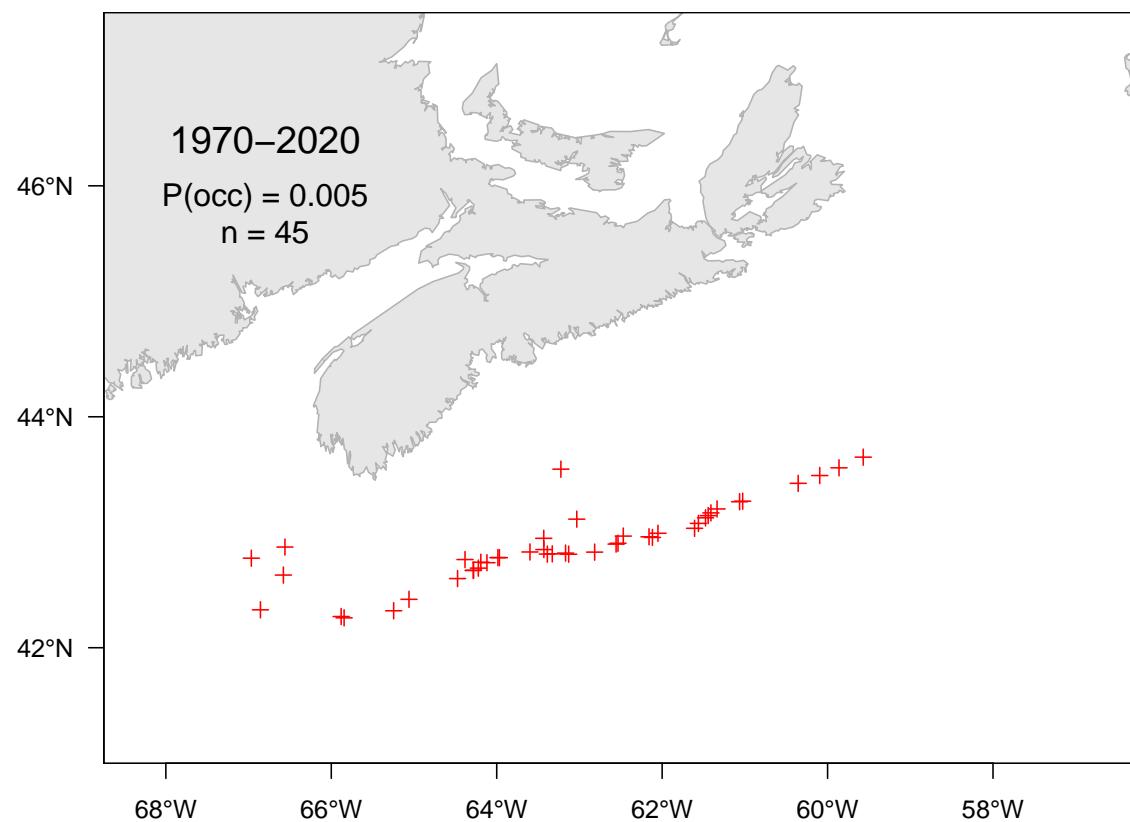


Figure 7.68A. Catch distribution for Longnose greeneye.

1065

## 7.69 Lanternfishes (Poissons-lanternes) - species code 150 (category LR)

1066

Scientific name: [Myctophidae](#)

1067

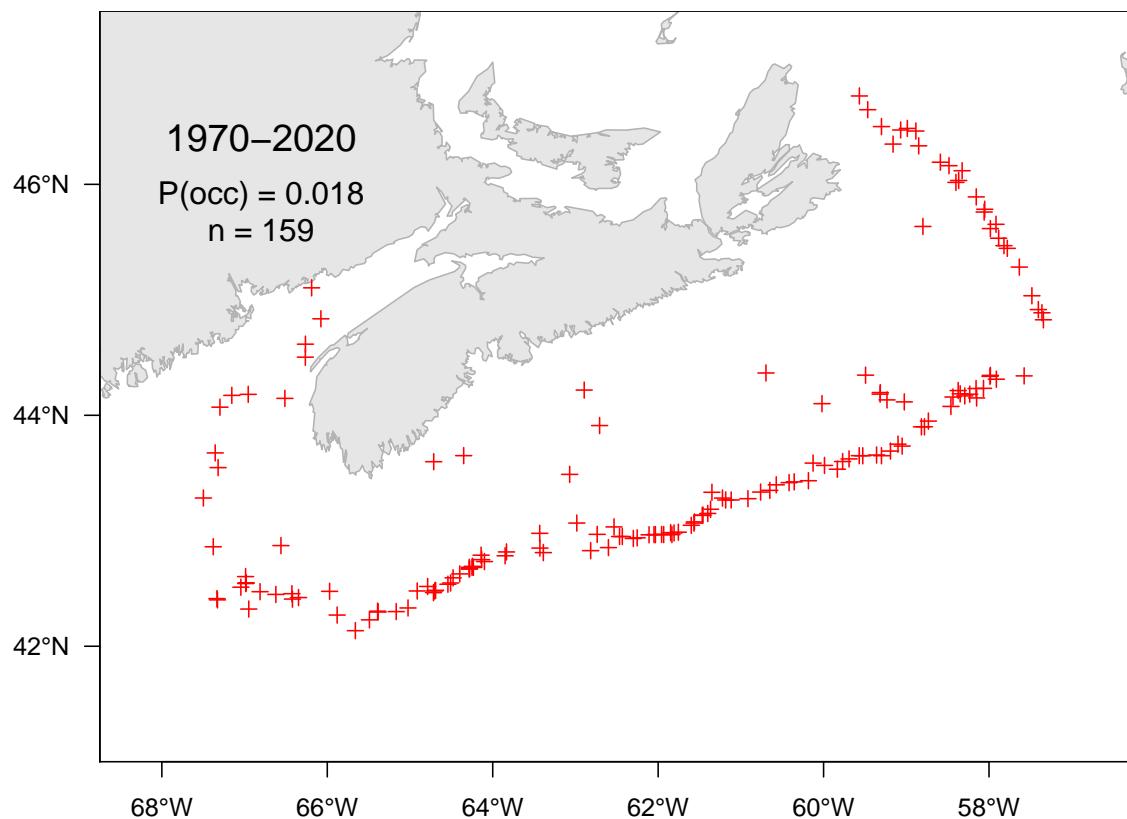


Figure 7.69A. Catch distribution for Lanternfishes.

1068

## 7.70 Shortnose greeneye (Éperlan du large) - species code 156 (category LR)

1069

Scientific name: [Chlorophthalmus agassizi](#)

1070

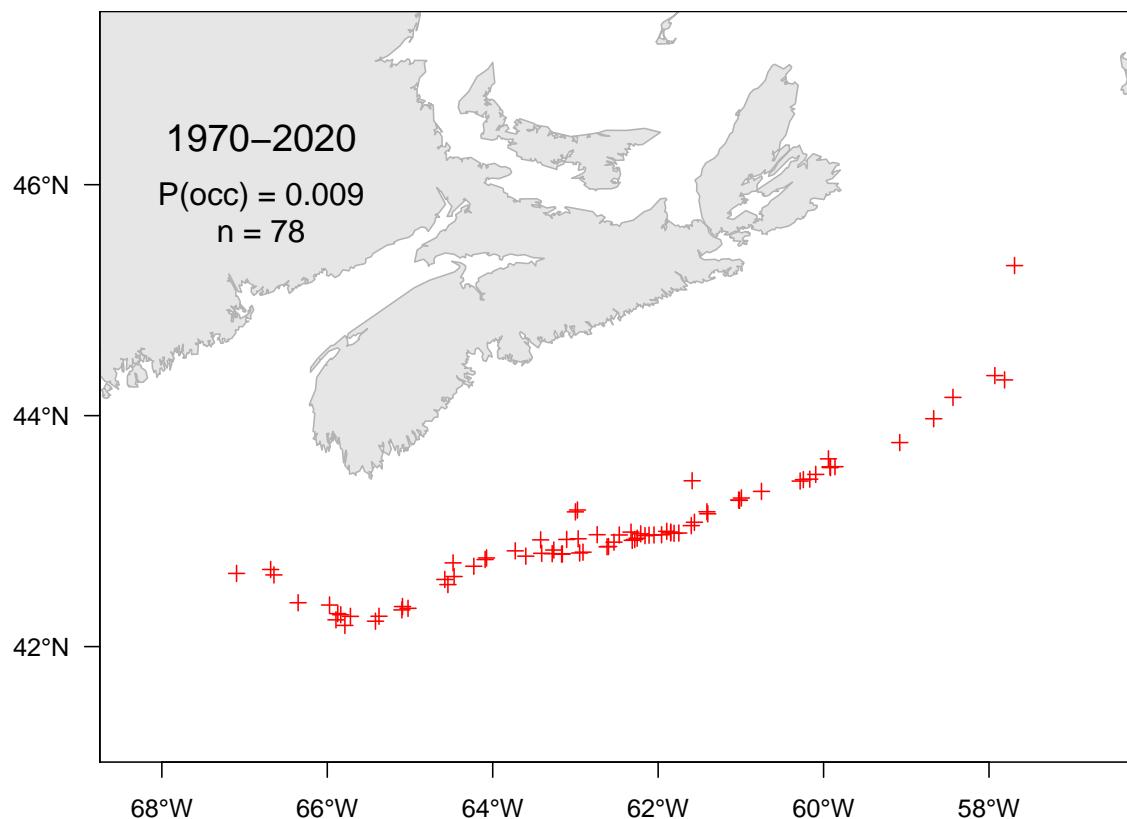


Figure 7.70A. Catch distribution for Shortnose greeneye.

1071

## 7.71 Silvery lightfish (Brossé améthyste) - species code 158 (category LR)

1072

Scientific name: [Maurolicus muelleri](#)

1073

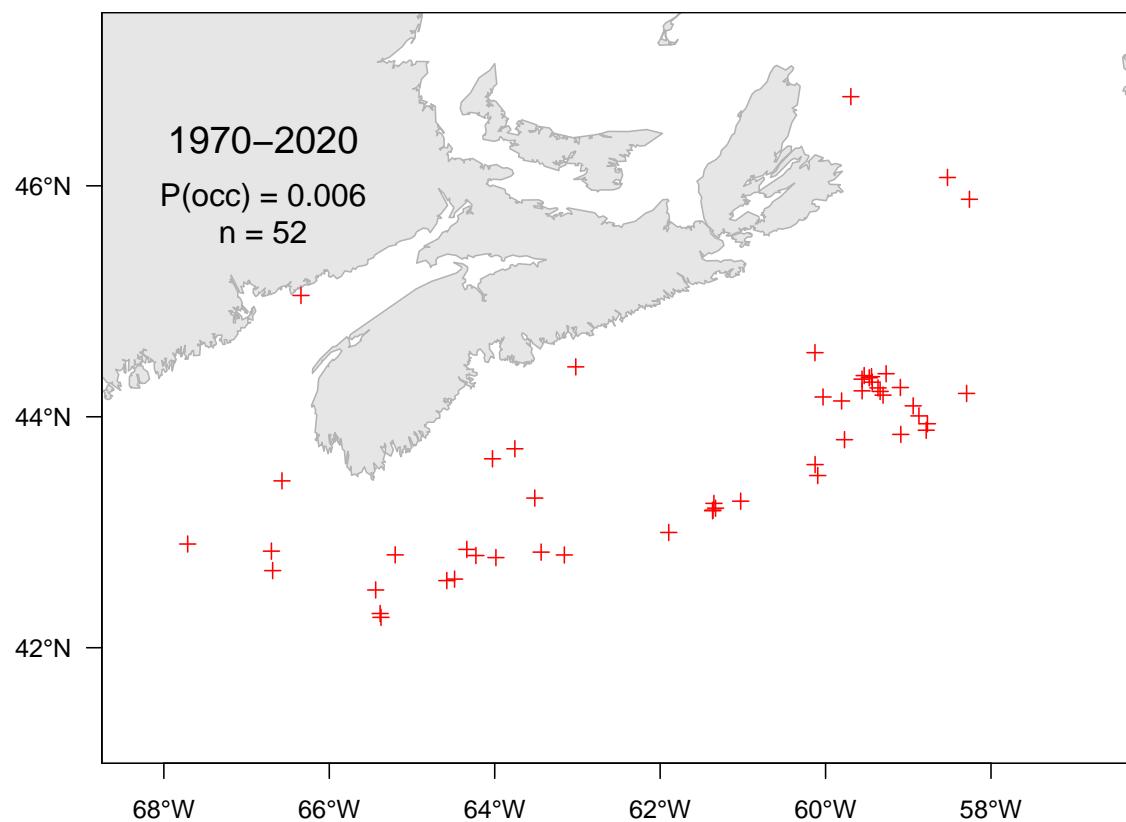


Figure 7.71A. Catch distribution for Silvery lightfish.

1074

## 7.72 Boa dragonfish (Dragon-boa) - species code 159 (category LR)

1075

Scientific name: [Stomias boa](#)

1076

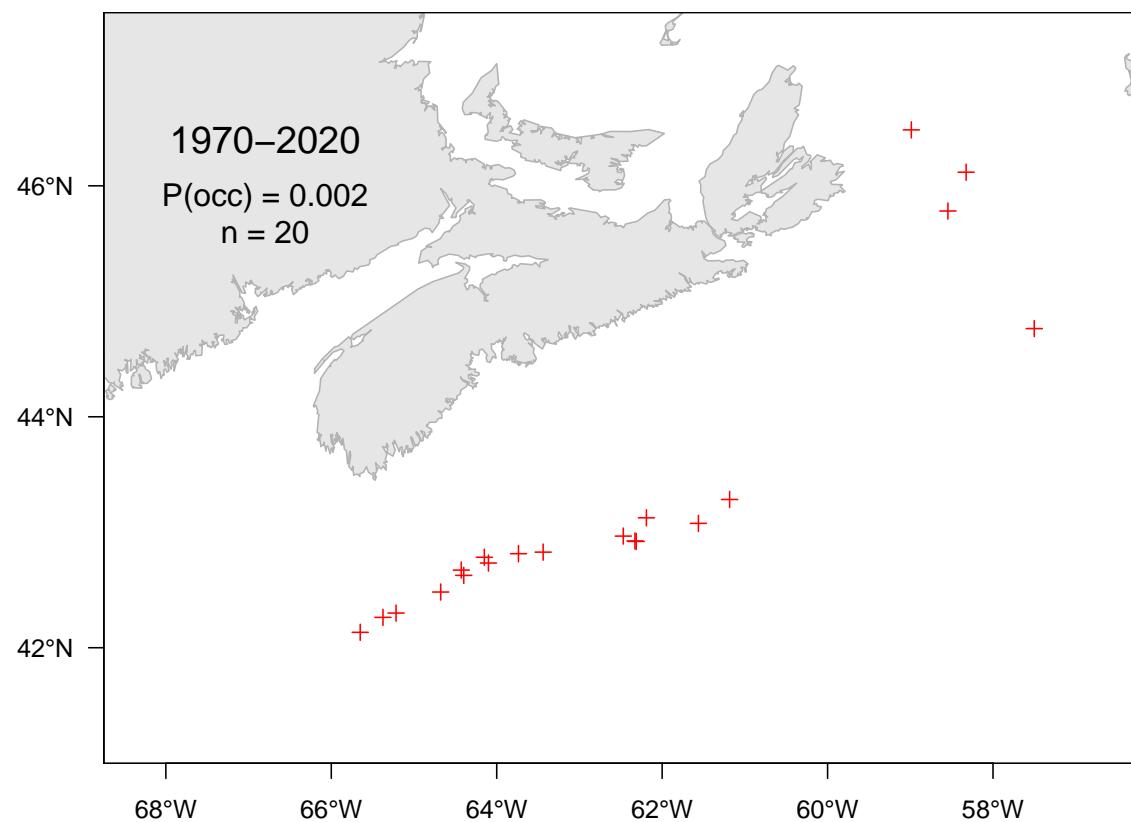


Figure 7.72A. Catch distribution for Boa dragonfish.

1077   **7.73 Shorthorn sculpin (Chabosseau à épines courtes) - species code 301 (category**  
1078   **LR)**

1079   Scientific name: [Myoxocephalus scorpius](#)

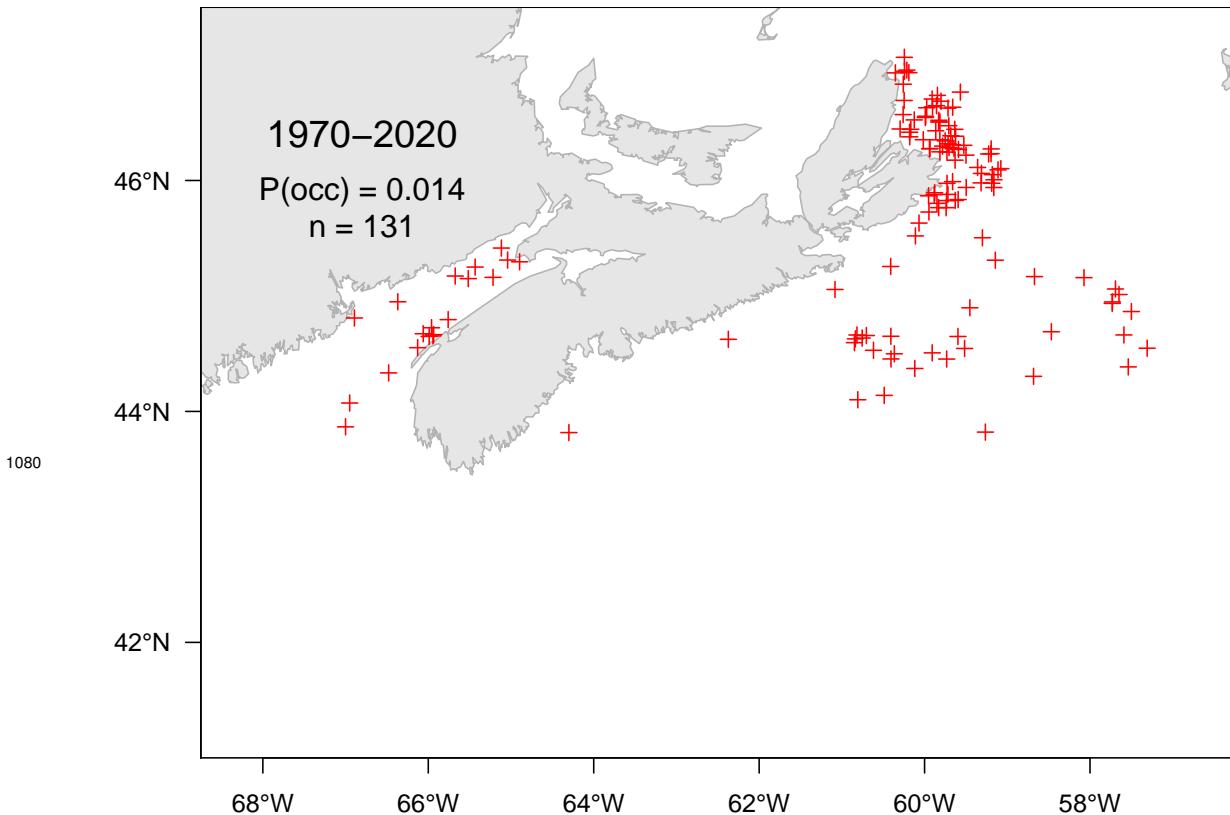


Figure 7.73A. Catch distribution for Shorthorn sculpin.

1081

## 7.74 Grubby (Chabosseau bronzé) - species code 303 (category LR)

1082

Scientific name: [Myoxocephalus aenaeus](#)

1083

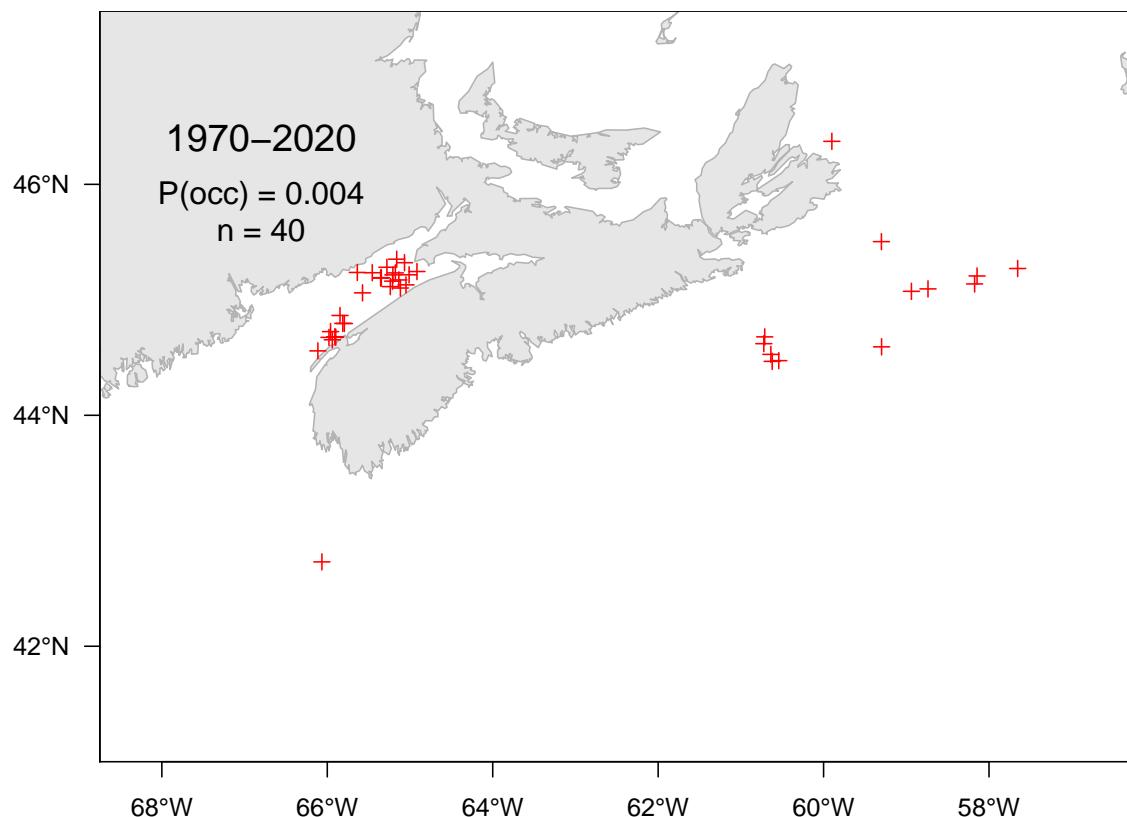


Figure 7.74A. Catch distribution for Grubby.

1084

## 7.75 Polar sculpin (Cotte polaire) - species code 307 (category LR)

1085

Scientific name: [Cottunculus microps](#)

1086

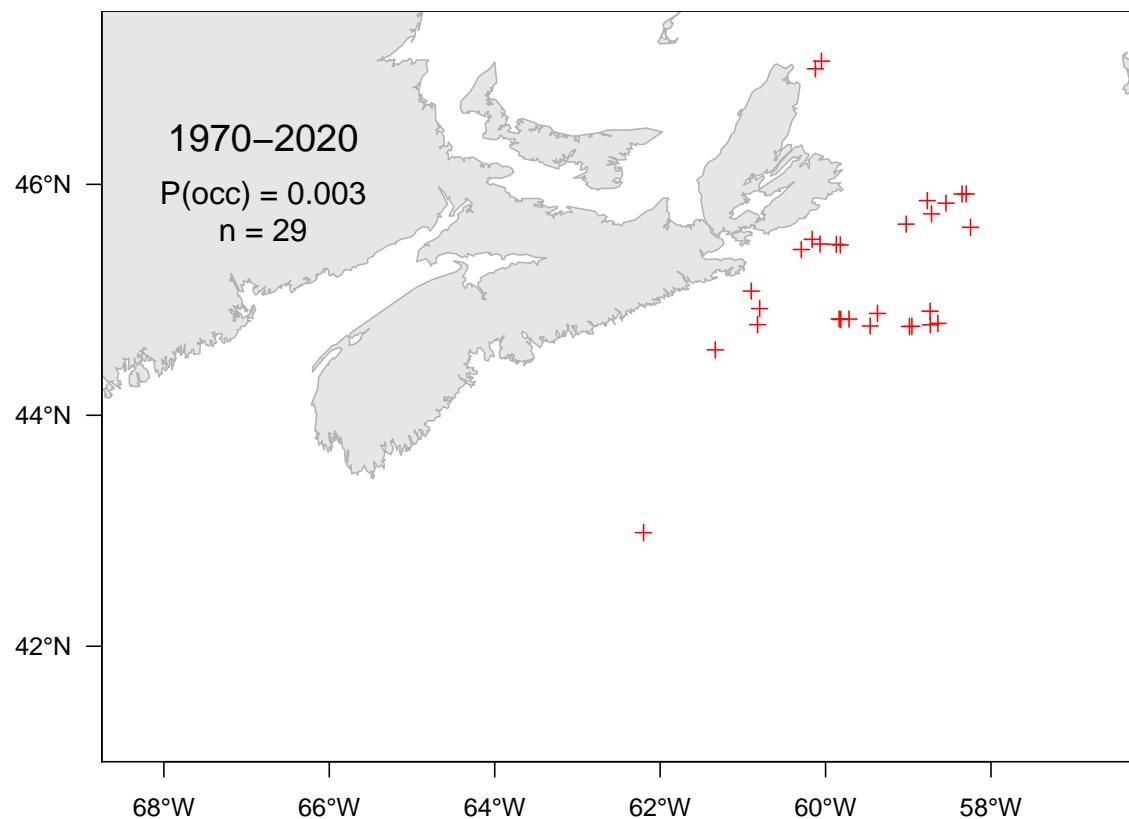


Figure 7.75A. Catch distribution for Polar sculpin.

1087

## 7.76 Spatulate sculpin (Icèle spatulée) - species code 314 (category LR)

1088

Scientific name: *Icelus spatula*

1089

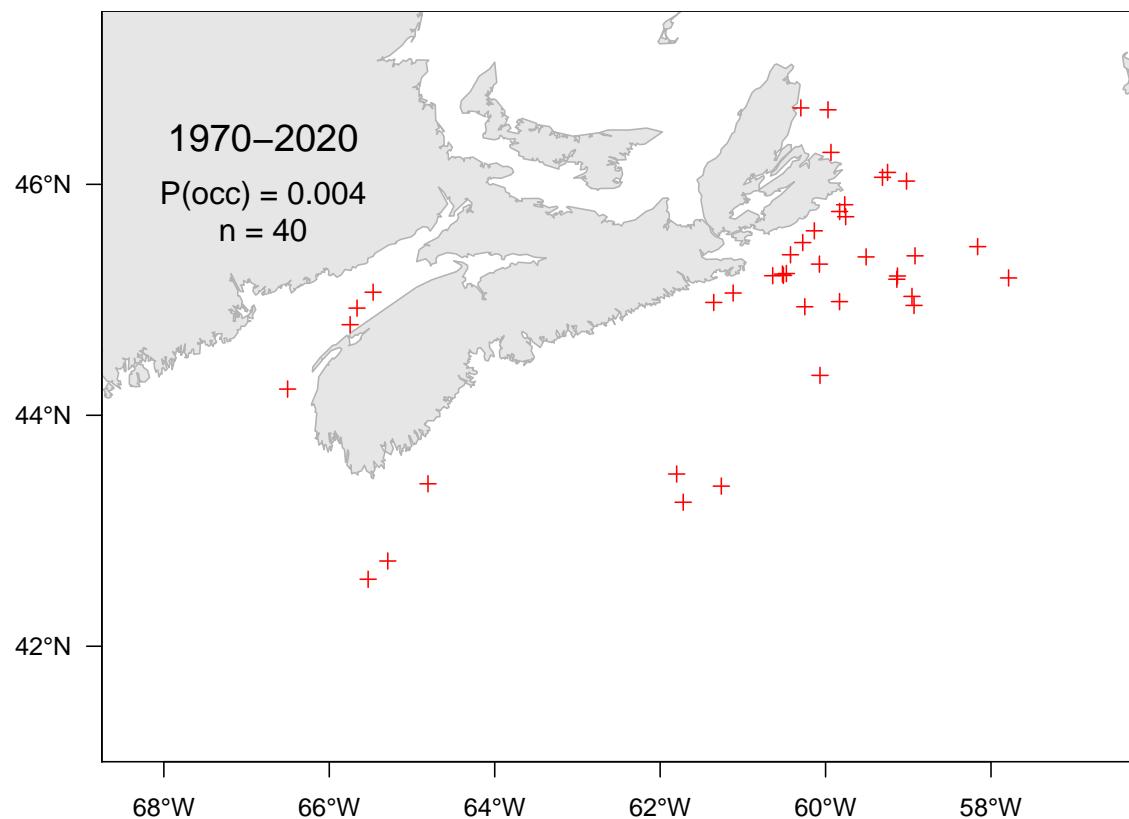


Figure 7.76A. Catch distribution for Spatulate sculpin.

1090

## 7.77 Arctic alligatorfish (Poisson-alligator arctique) - species code 341 (category LR)

1091

Scientific name: [Ulcina olrikii](#)

1092

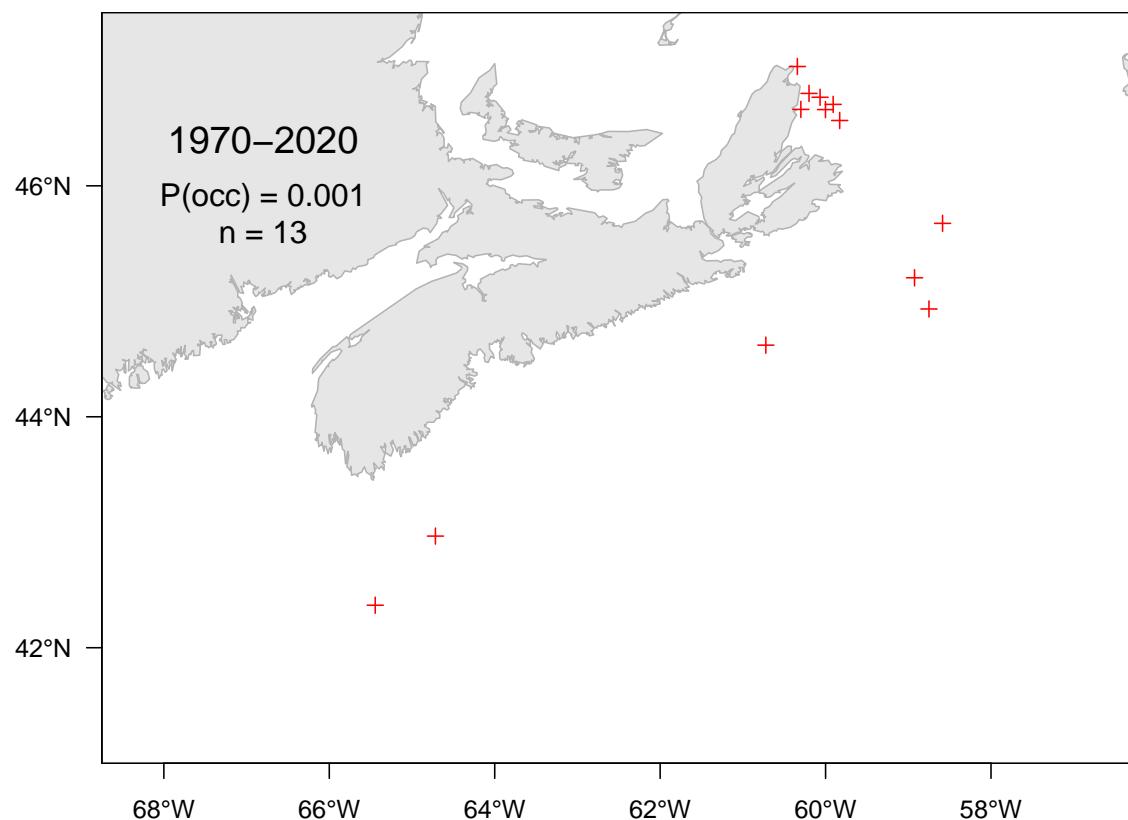


Figure 7.77A. Catch distribution for Arctic alligatorfish.

1093

## 7.78 Alligatorfishes (Poissons-alligator) - species code 351 (category LR)

1094

Scientific name: [Agonidae](#)

1095

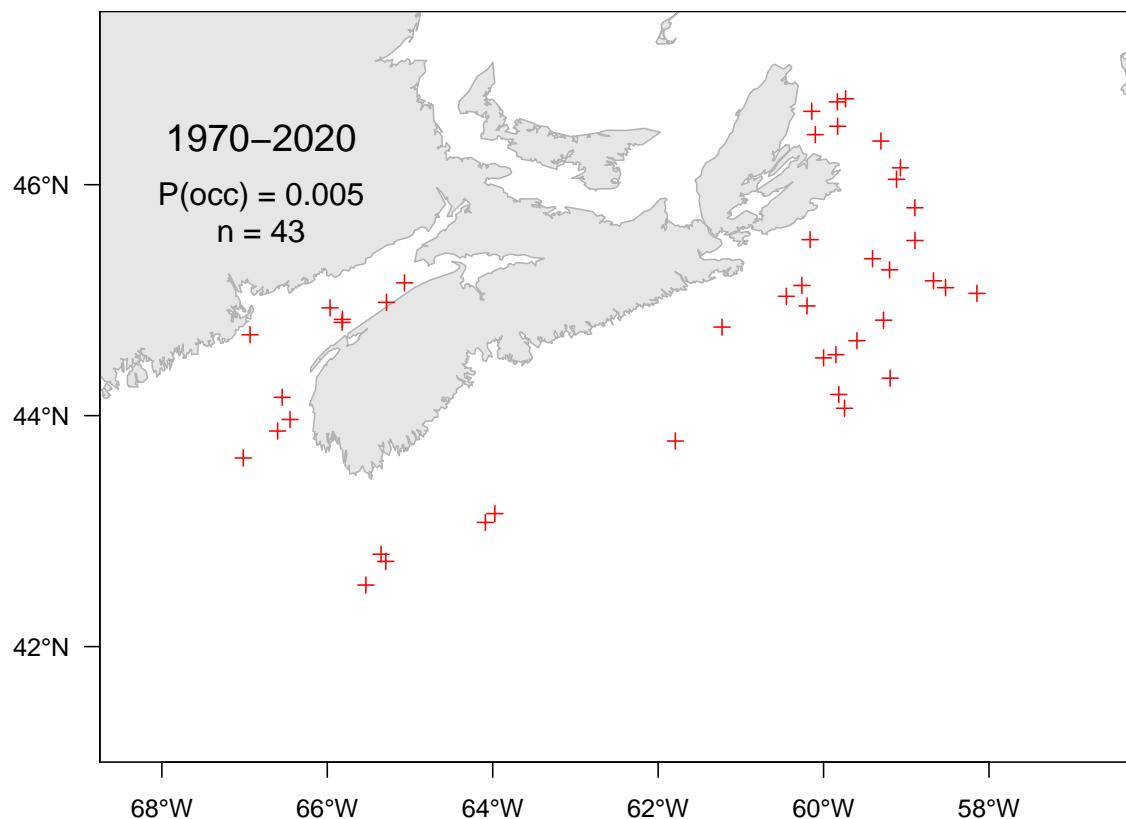


Figure 7.78A. Catch distribution for Alligatorfishes.

1096

## 7.79 Roughnose grenadier (Grenadier-scie) - species code 412 (category LR)

1097

Scientific name: [Trachyrincus murrayi](#)

1098

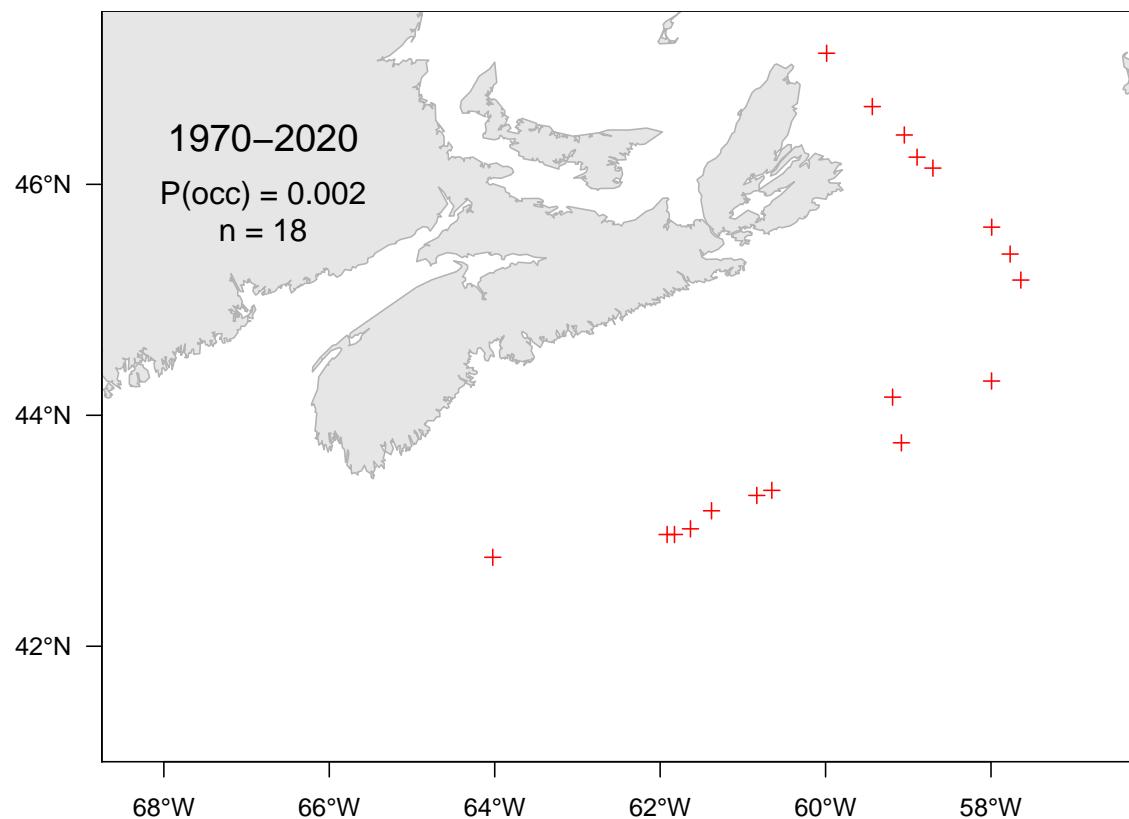


Figure 7.79A. Catch distribution for Roughnose grenadier.

1099

## 7.80 Roundnose grenadier (Grenadier de roche) - species code 414 (category LR)

1100

Scientific name: [Coryphaenoides rupestris](#)

1101

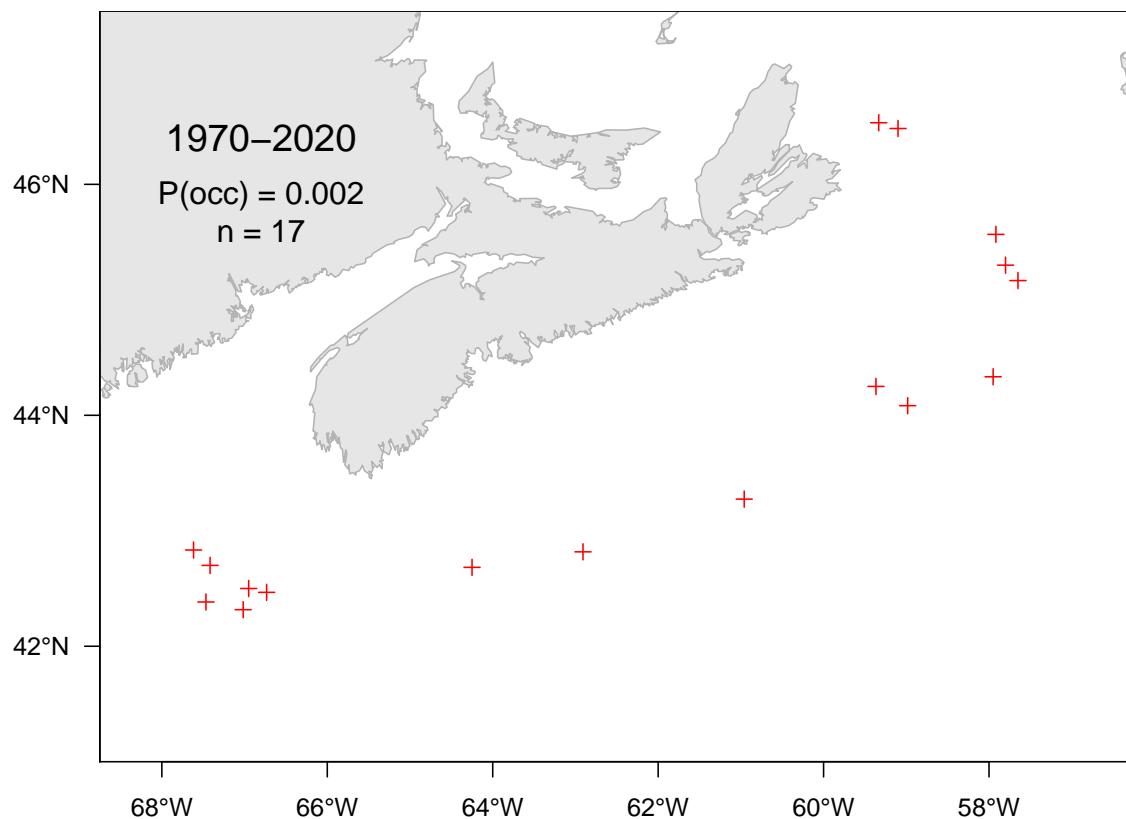


Figure 7.80A. Catch distribution for Roundnose grenadier.

1102

## 7.81 Atlantic seasnail (*Limace atlantique*) - species code 503 (category LR)

1103

Scientific name: [Liparis atlanticus](#)

1104

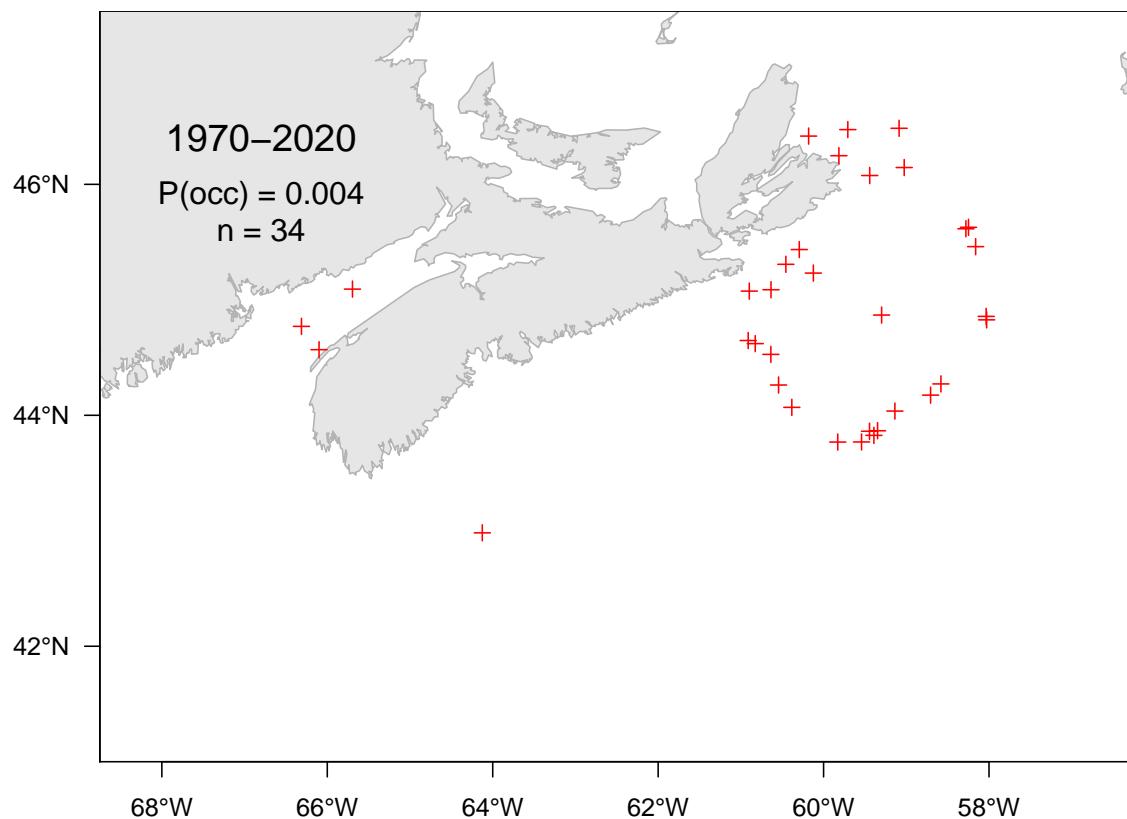


Figure 7.81A. Catch distribution for Atlantic seasnail.

1105

## 7.82 Gelatinous snailfish (*Limace gélatineuse*) - species code 505 (category LR)

1106

Scientific name: [Liparis fabricii](#)

1107

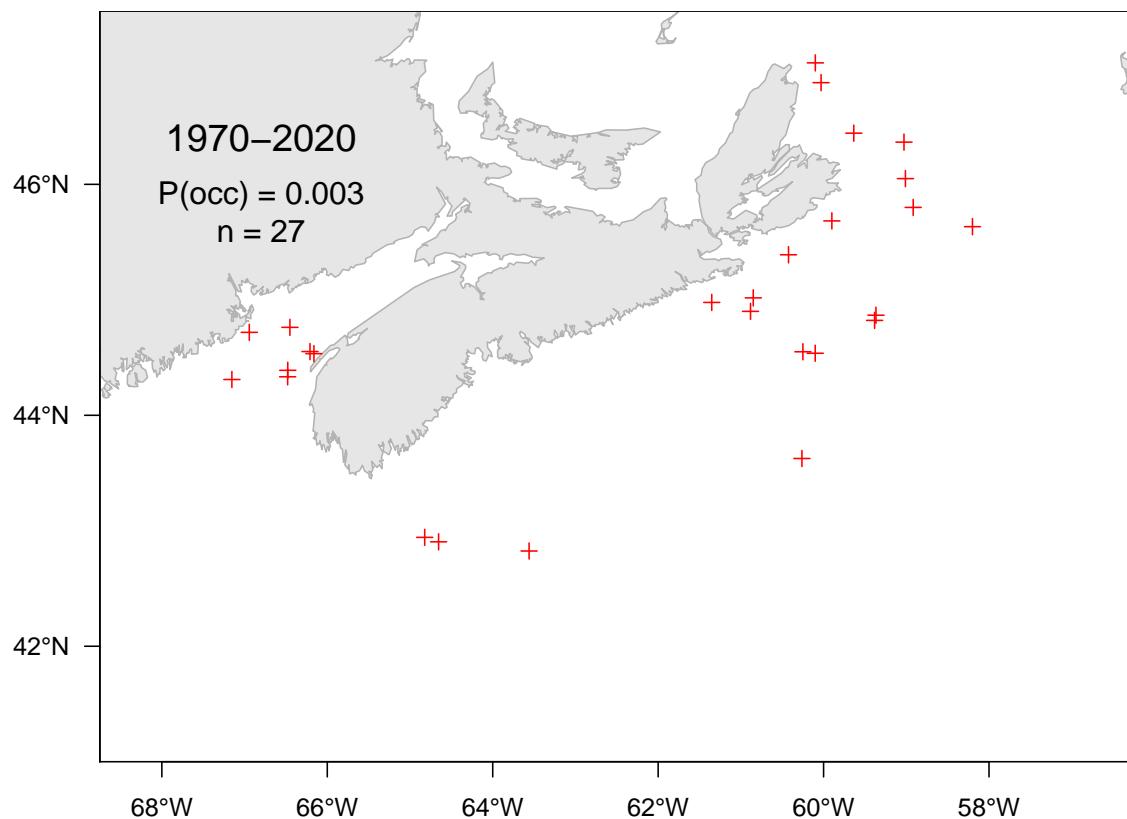


Figure 7.82A. Catch distribution for Gelatinous snailfish.

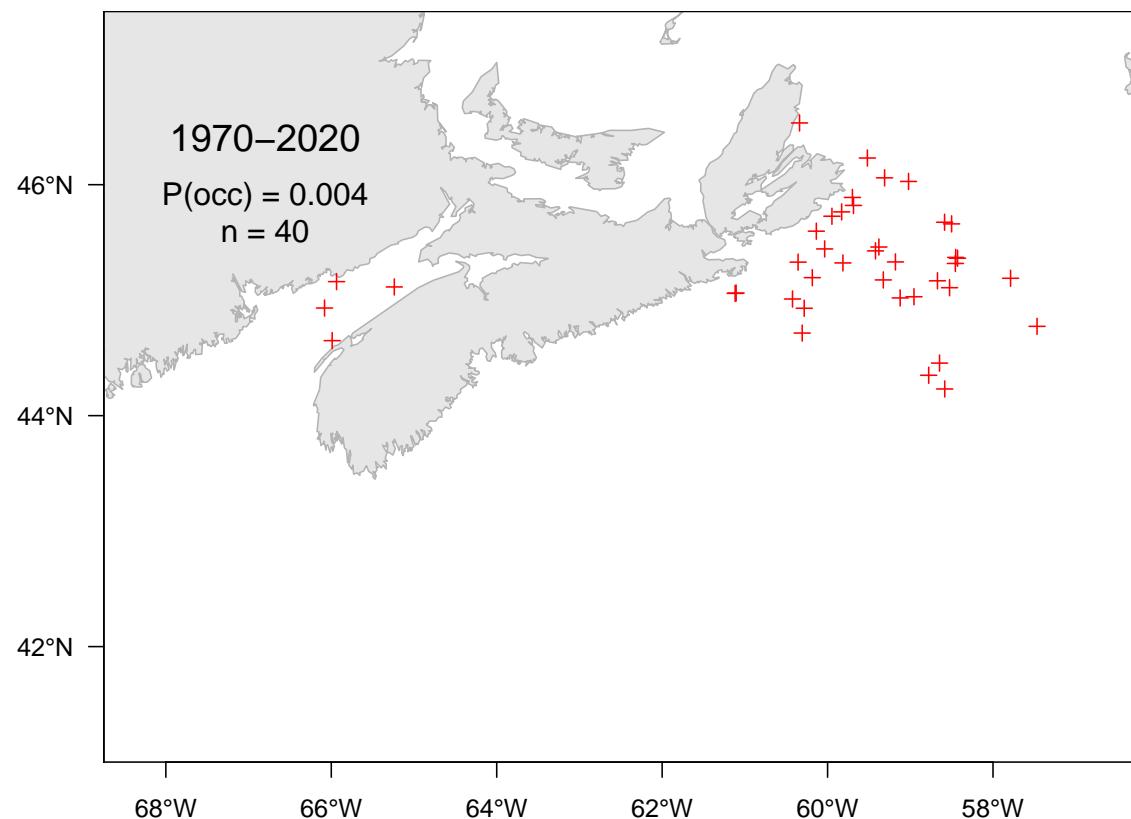
1108

### 7.83 Variegated snailfish (*Limace marbée*) - species code 512 (category LR)

1109

Scientific name: [Liparis gibbus](#)

1110



1111

Figure 7.83A. Catch distribution for Variegated snailfish.

1111 7.84 Sea tadpole (Petite limace de mer) - species code 520 (category LR)

1112 Scientific name: [Careproctus reinhardtii](#)

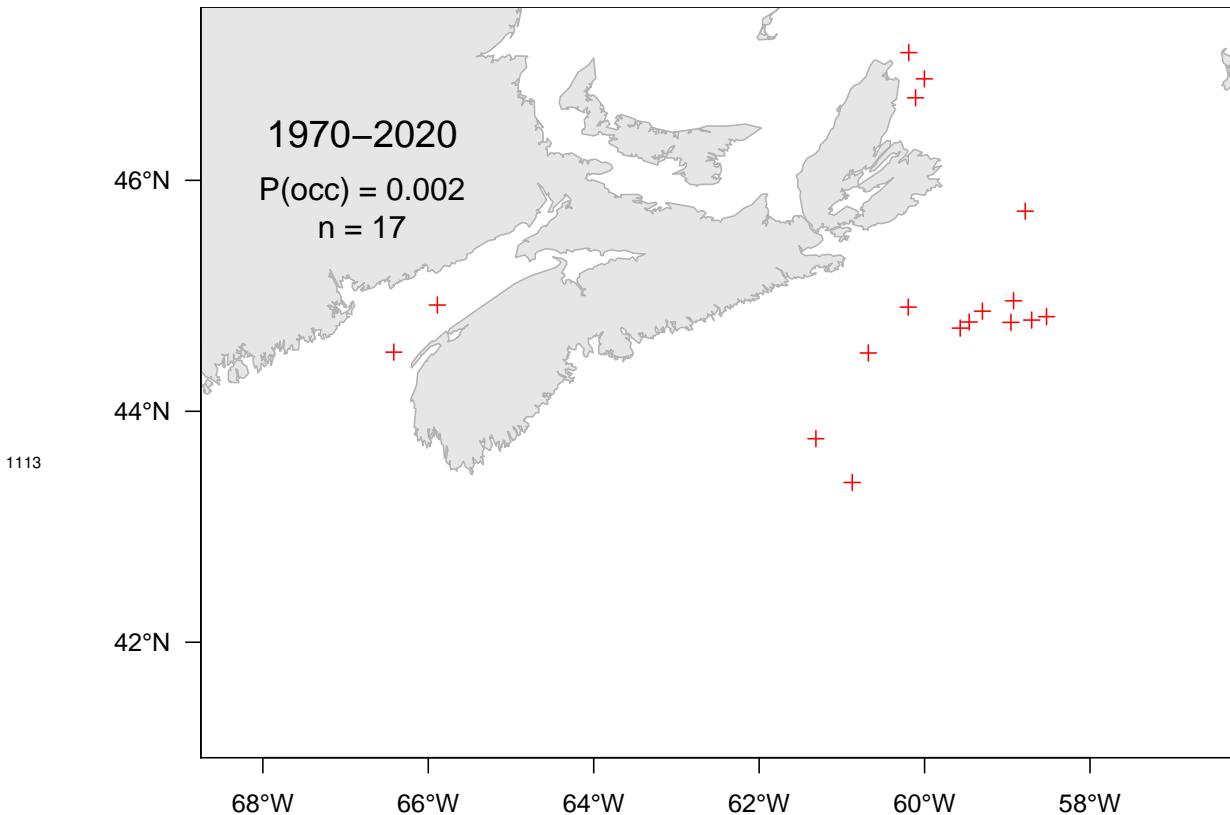


Figure 7.84A. Catch distribution for Sea tadpole.

1114

## 7.85 Wolf eelpout (*Lycodes à tête longue*) - species code 603 (category LR)

1115

Scientific name: *Lycenchelys verrillii*

1116

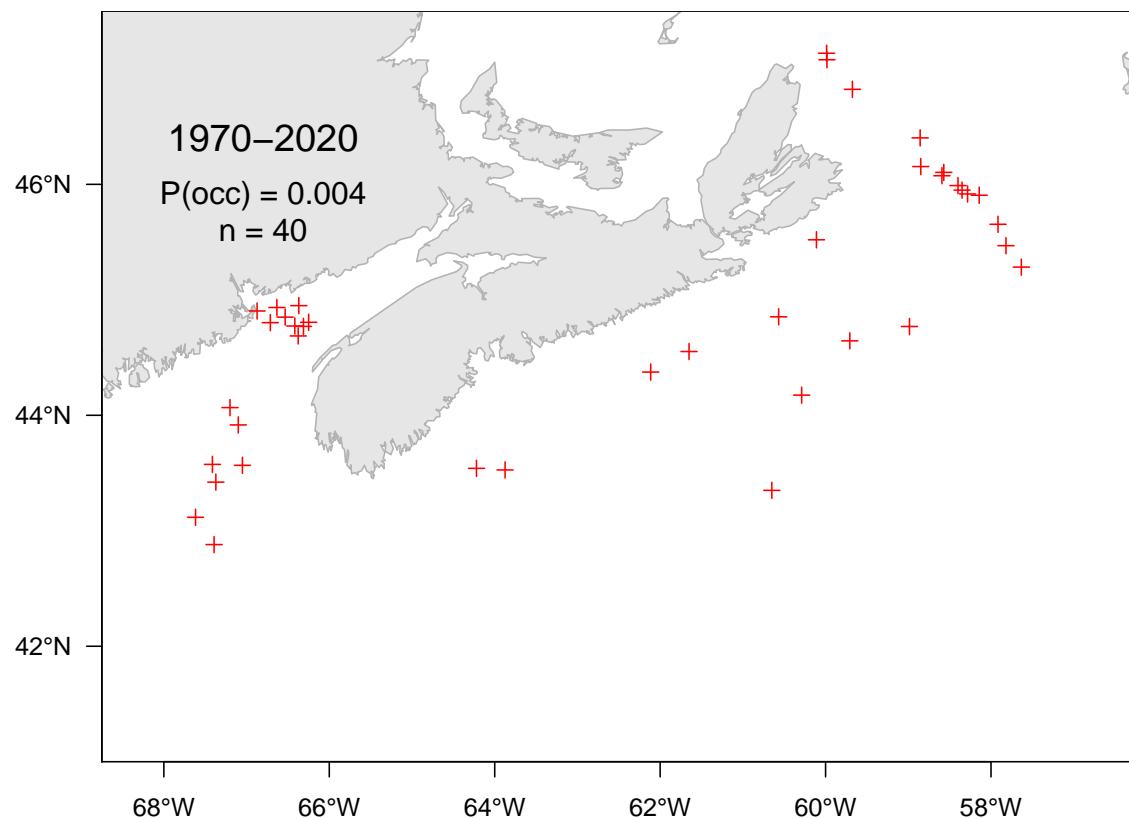


Figure 7.85A. Catch distribution for Wolf eelpout.

1117    7.86 Slender snipe eel (*Avocette ruban*) - species code 604 (category LR)

1118    Scientific name: [Nemichthys scolopaceus](#)

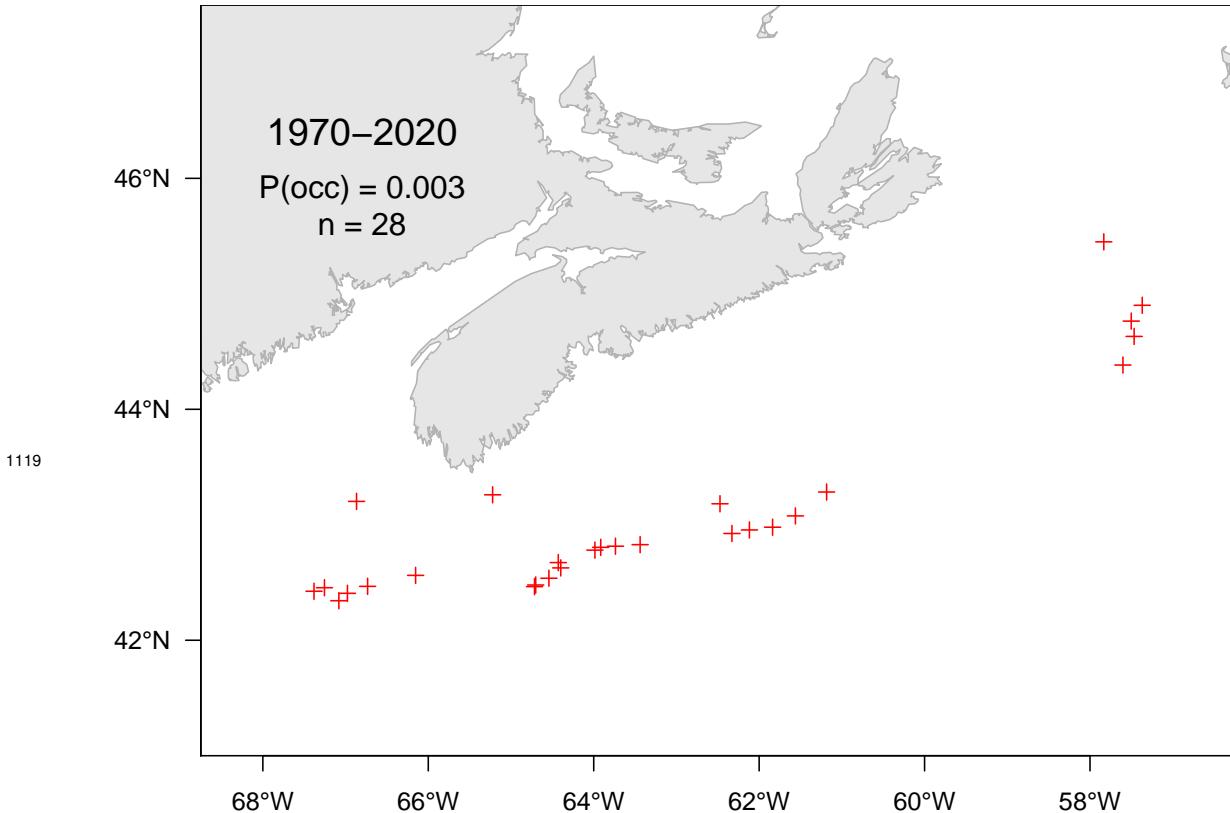
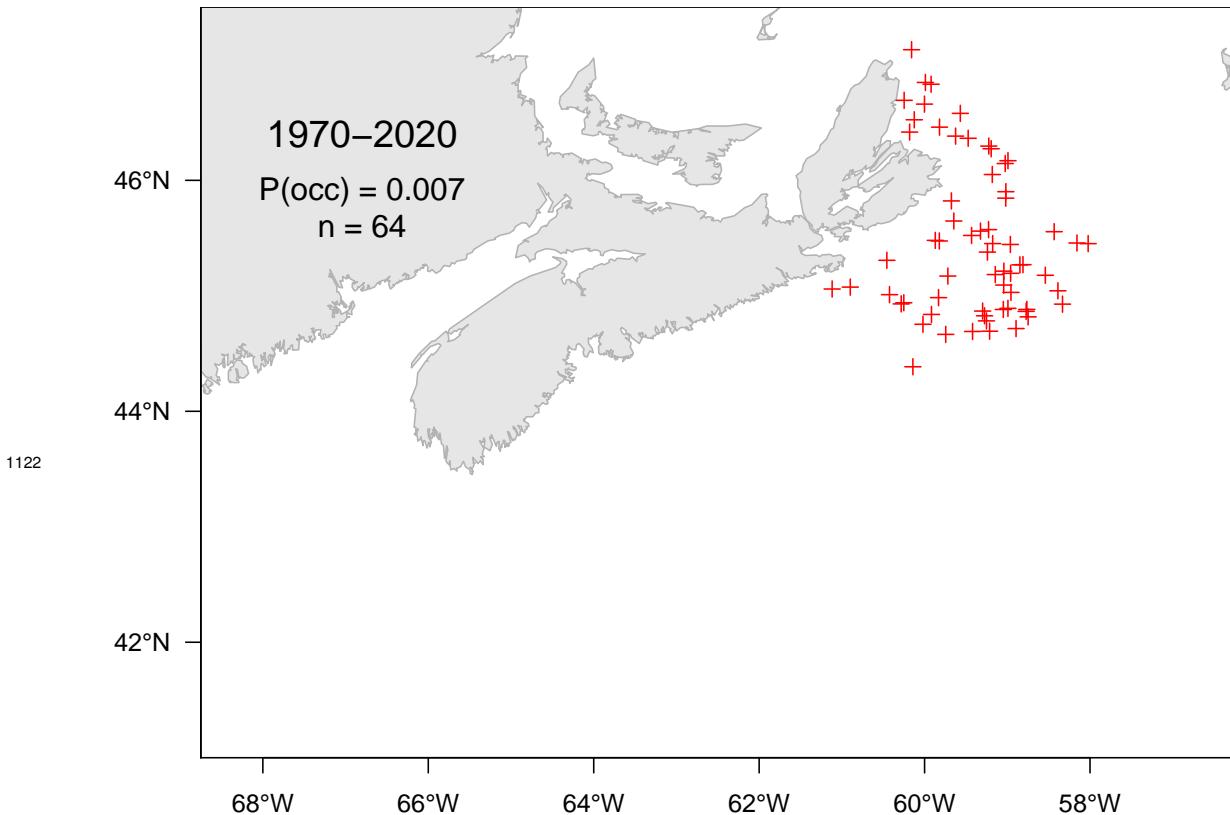


Figure 7.86A. Catch distribution for Slender snipe eel.

1120      **7.87 Newfoundland eelpout (Lycodes du Labrador) - species code 619 (category LR)**

1121      Scientific name: [Lycodes terraenovae](#)



1123    7.88 Newfoundland eelpout (*Lycodes* du Labrador) - species code 620 (category LR)

1124    Scientific name: [Lycodes lavalaei](#)

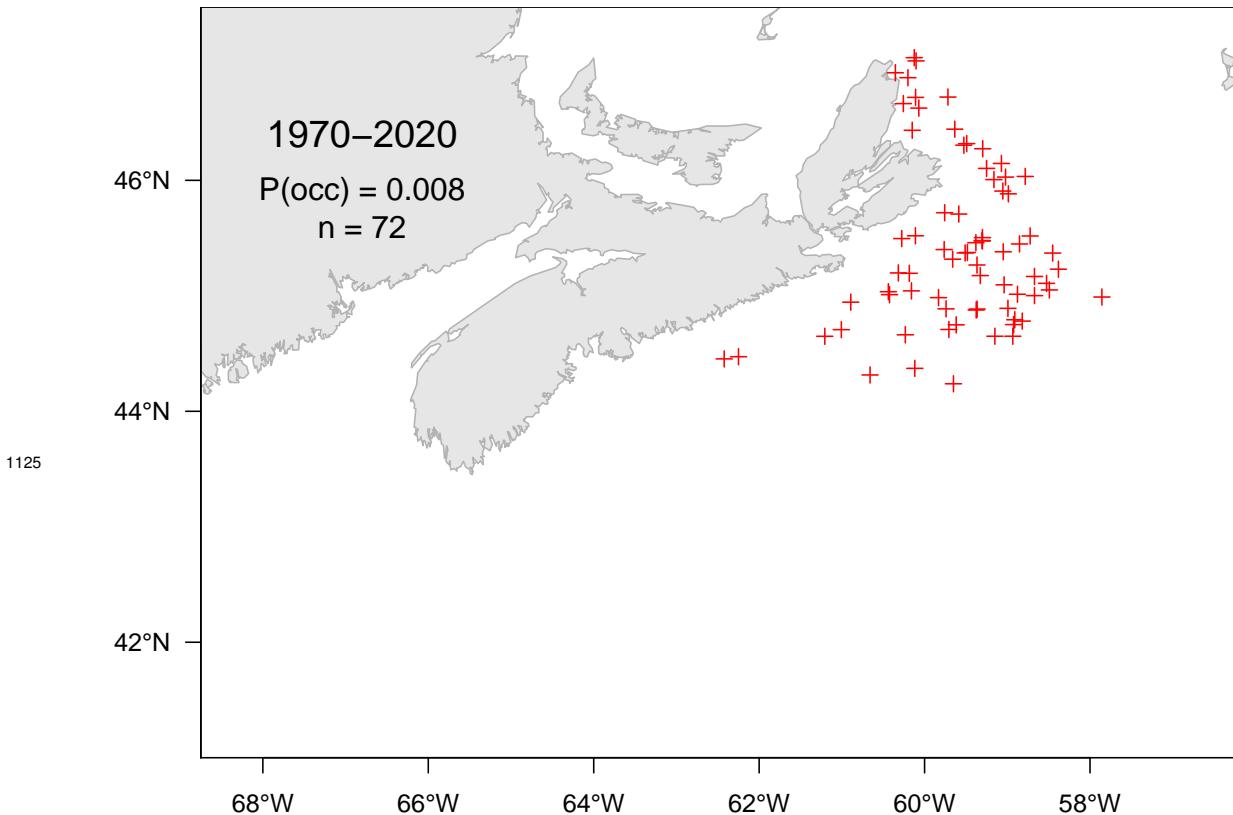


Figure 7.88A. Catch distribution for Newfoundland eelpout.

1126

### 7.89 Rock gunnel (Sigouine de roche) - species code 621 (category LR)

1127

Scientific name: [Pholis gunnellus](#)

1128

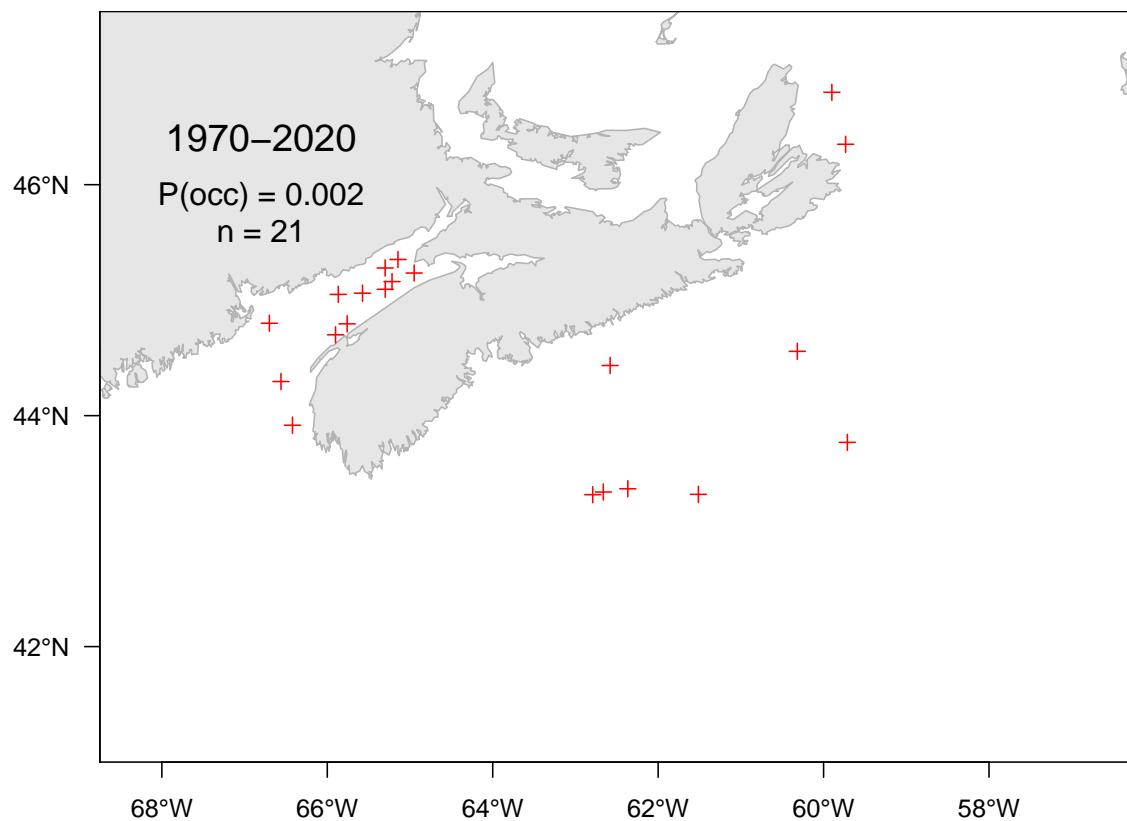


Figure 7.89A. Catch distribution for Rock gunnel.

1129    7.90 Radiated shanny (*Ulvaire deux-lignes*) - species code 625 (category LR)

1130    Scientific name: *Ulvaria subbifurcata*

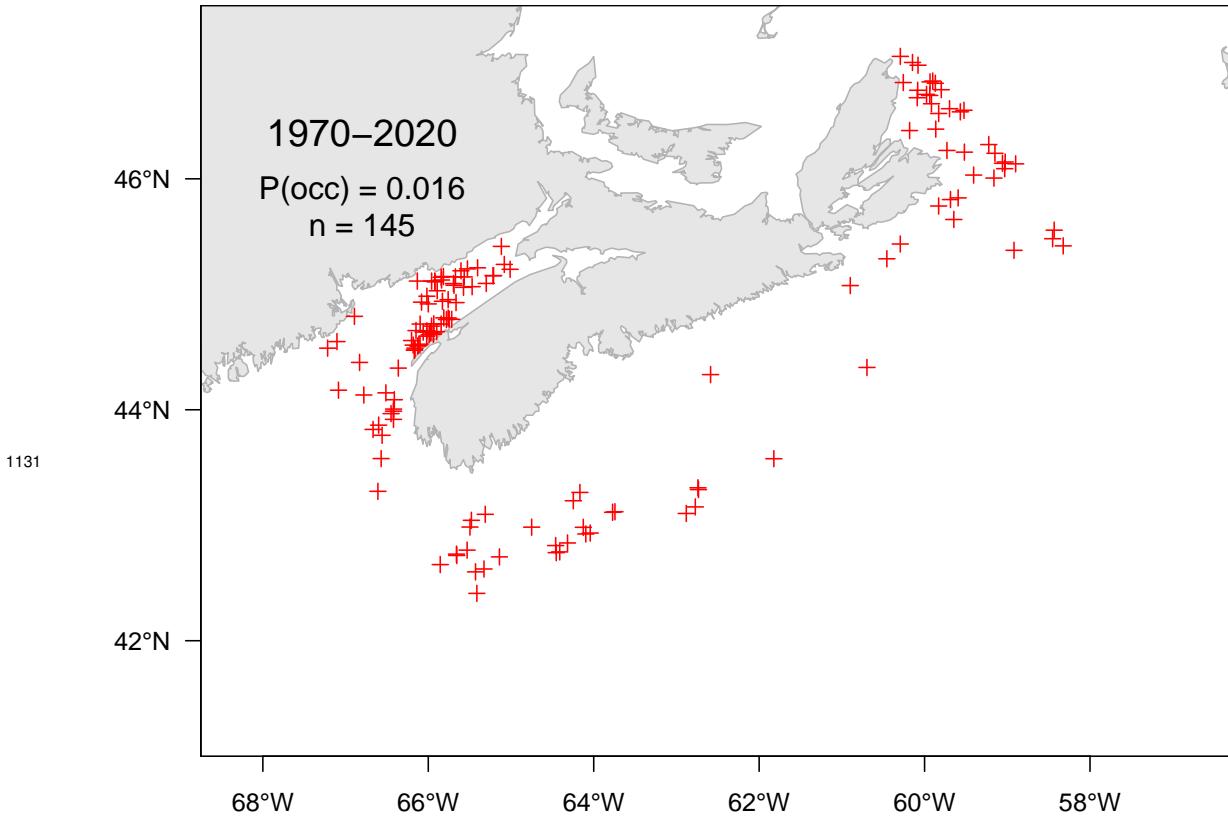


Figure 7.90A. Catch distribution for Radiated shanny.

1132

## 7.91 Fourline snakeblenny (Quatre-lignes atlantique) - species code 626 (category LR)

1133

Scientific name: [Eumesogrammus praecisus](#)

1134

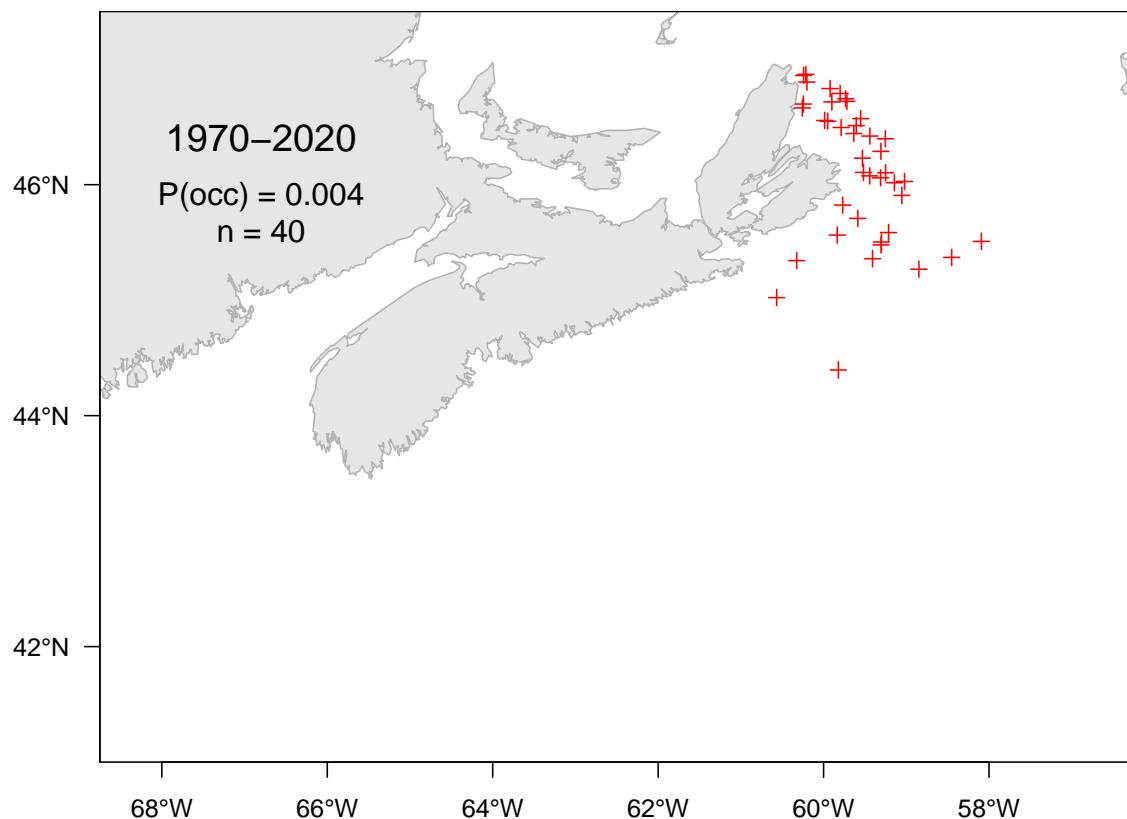


Figure 7.91A. Catch distribution for Fourline snakeblenny.

1135

## 7.92 Wrymouth (Terrassier tacheté) - species code 630 (category LR)

1136

Scientific name: [Cryptacanthodes maculatus](#)

1137

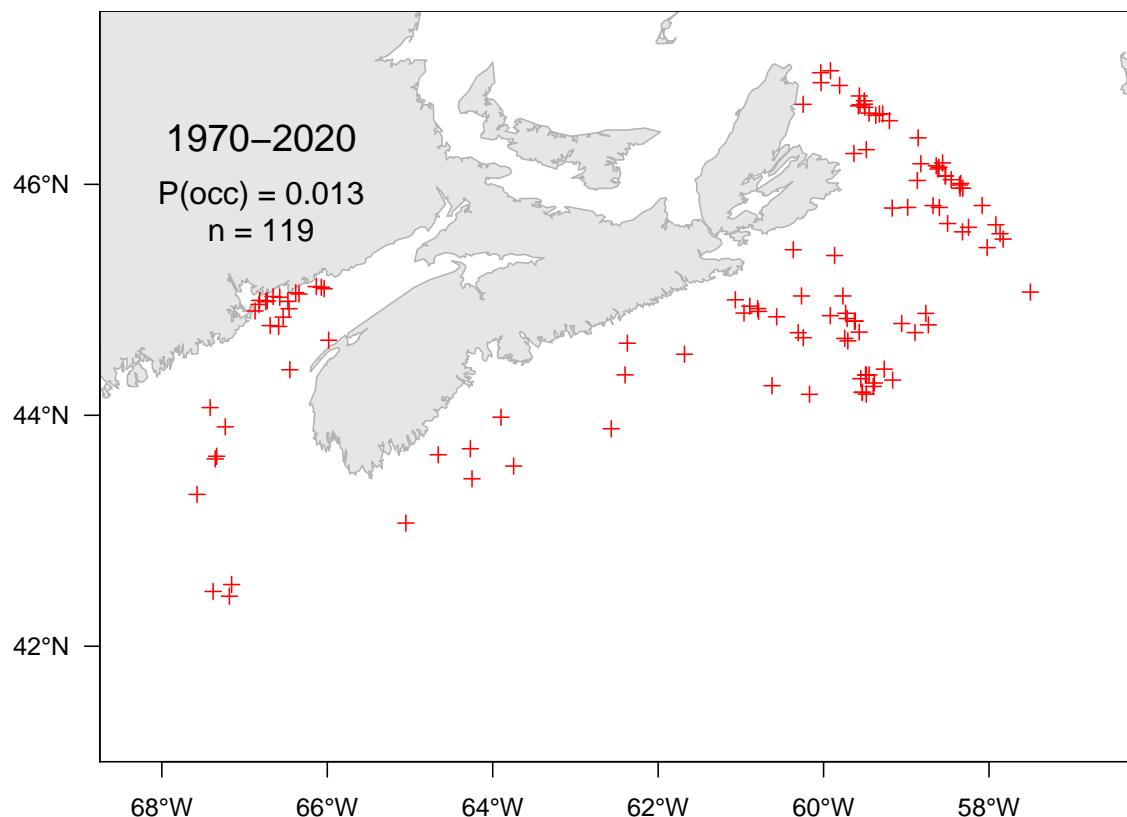


Figure 7.92A. Catch distribution for Wrymouth.

1138

### 7.93 Spotfin dragonet (Dragonnet tacheté) - species code 637 (category LR)

1139

Scientific name: [Foetorepus agassizii](#)

1140

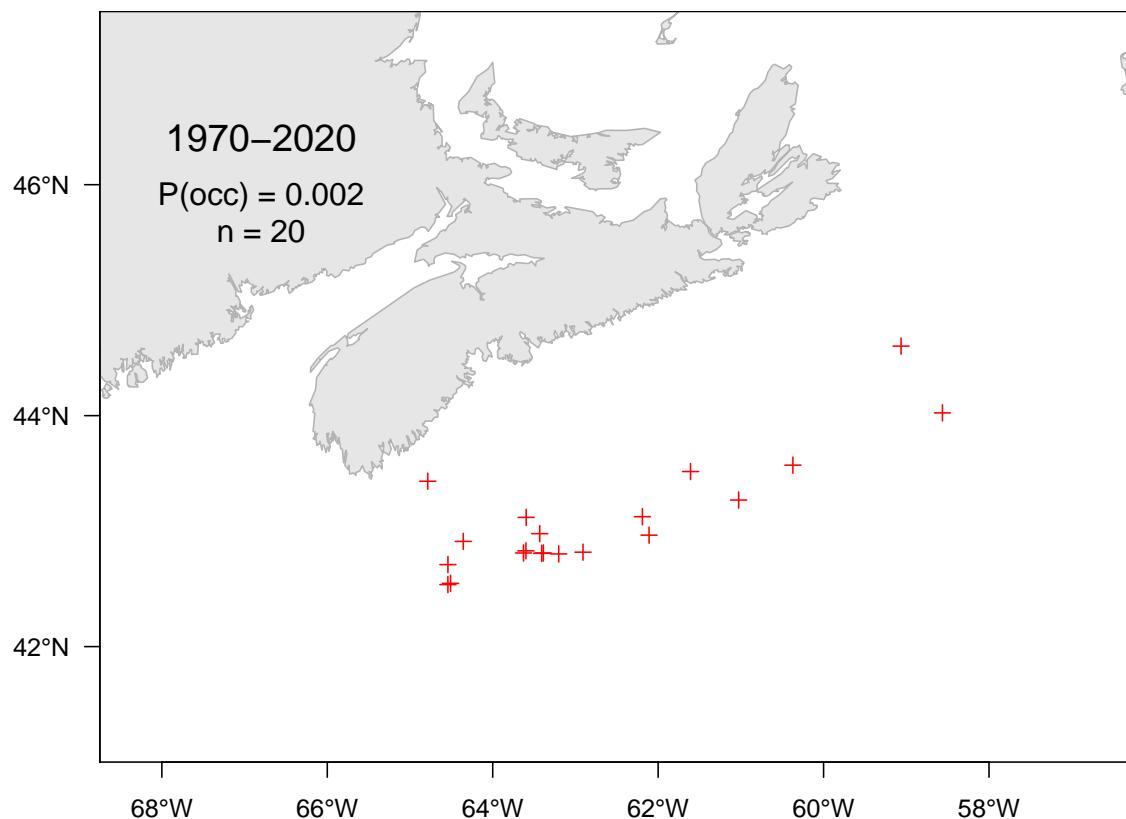


Figure 7.93A. Catch distribution for Spotfin dragonet.

1141

## 7.94 Arctic eelpout (*Lycodes arctique*) - species code 641 (category LR)

1142

Scientific name: [Lycodes reticulatus](#)

1143

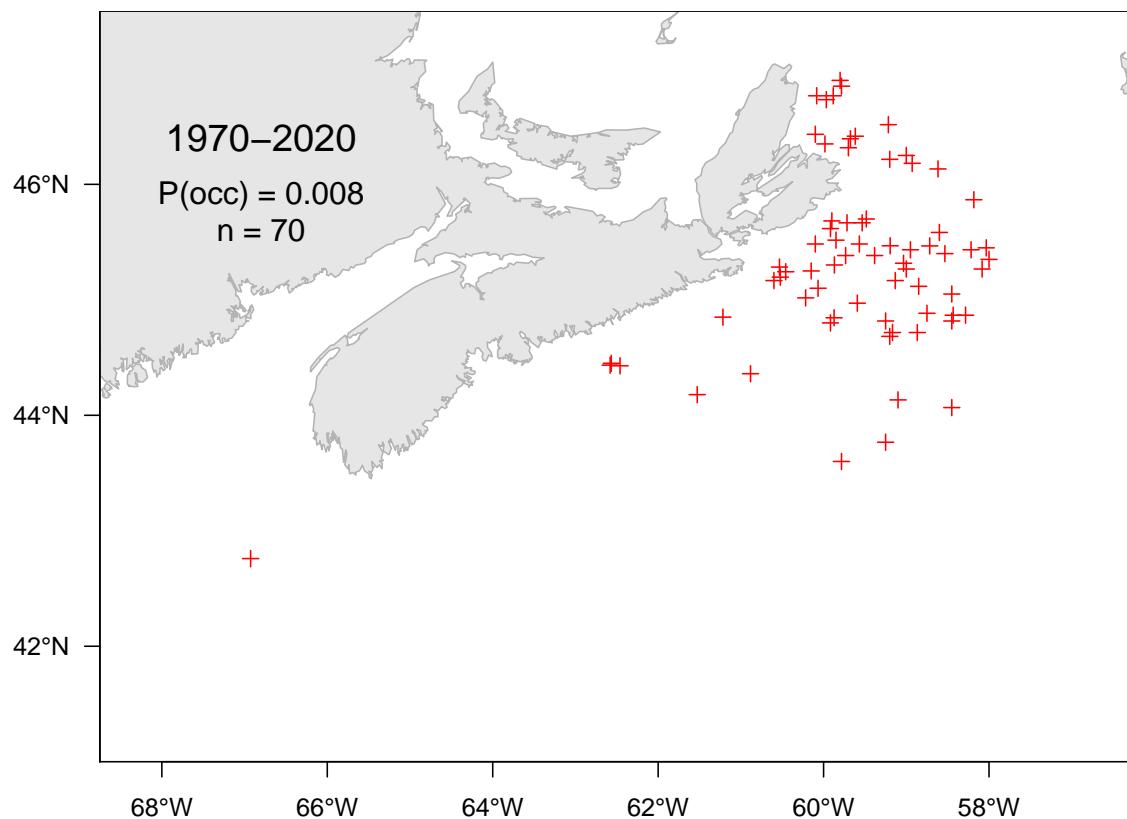


Figure 7.94A. Catch distribution for Arctic eelpout.

1144

## 7.95 Atlantic soft pout (*Molasse atlantique*) - species code 646 (category LR)

1145

Scientific name: [Melanostigma atlanticum](#)

1146

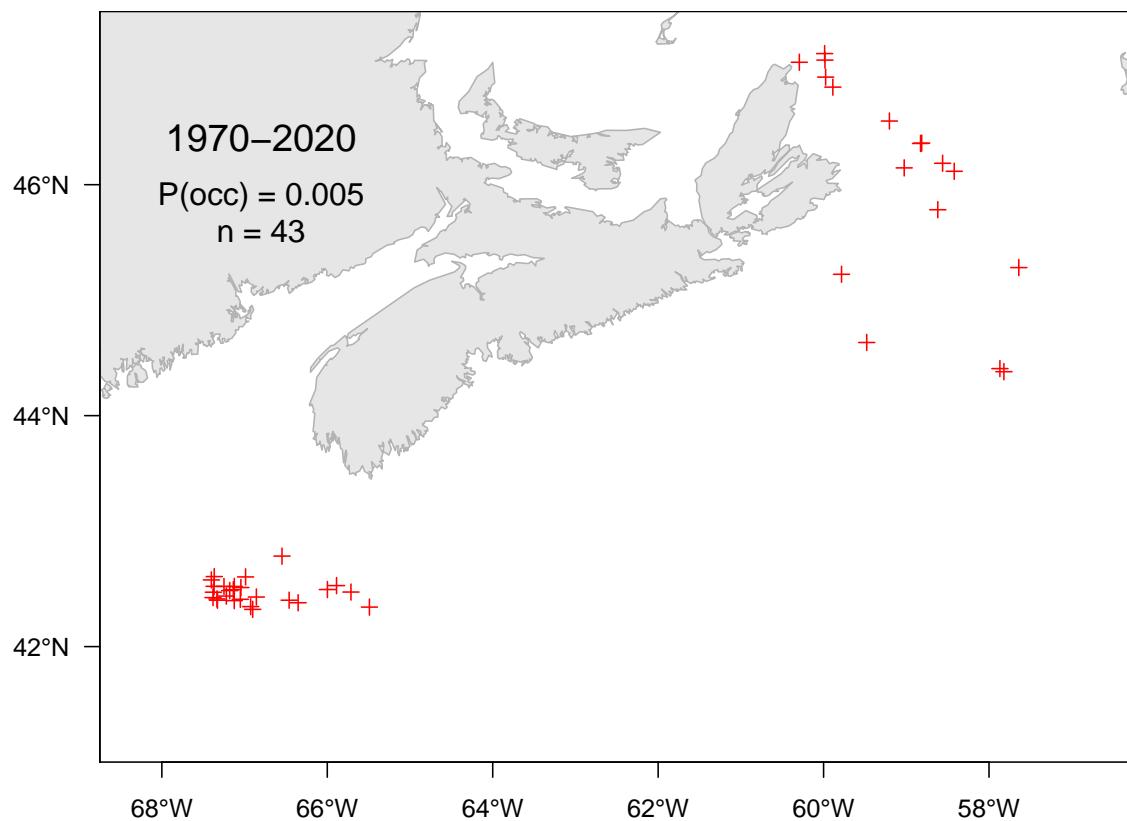


Figure 7.95A. Catch distribution for Atlantic soft pout.

1147

## 7.96 Silvery John dory (Saint Pierre argenté) - species code 704 (category LR)

1148

Scientific name: [Zenopsis conchifer](#)

1149

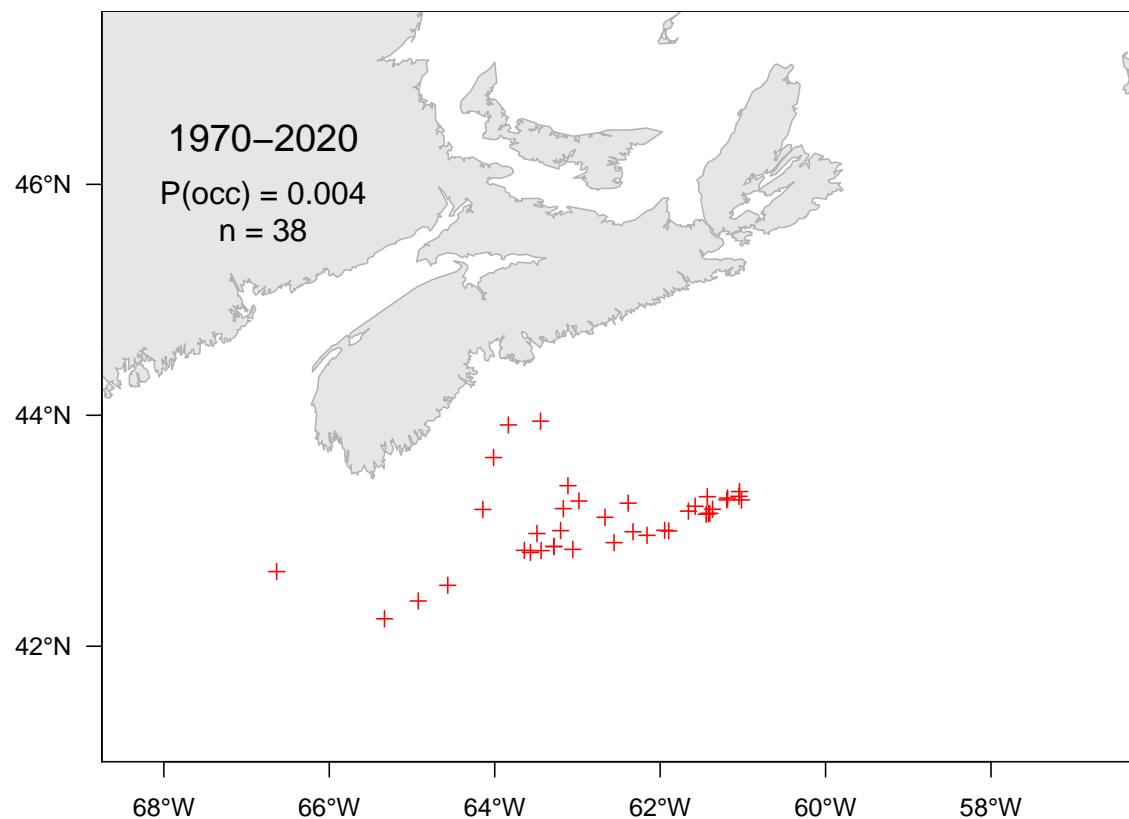


Figure 7.96A. Catch distribution for Silvery John dory.

1150

## 7.97 White barracudina (*Lussion blanc*) - species code 712 (category LR)

1151

Scientific name: [Arctozenus risso](#)

1152

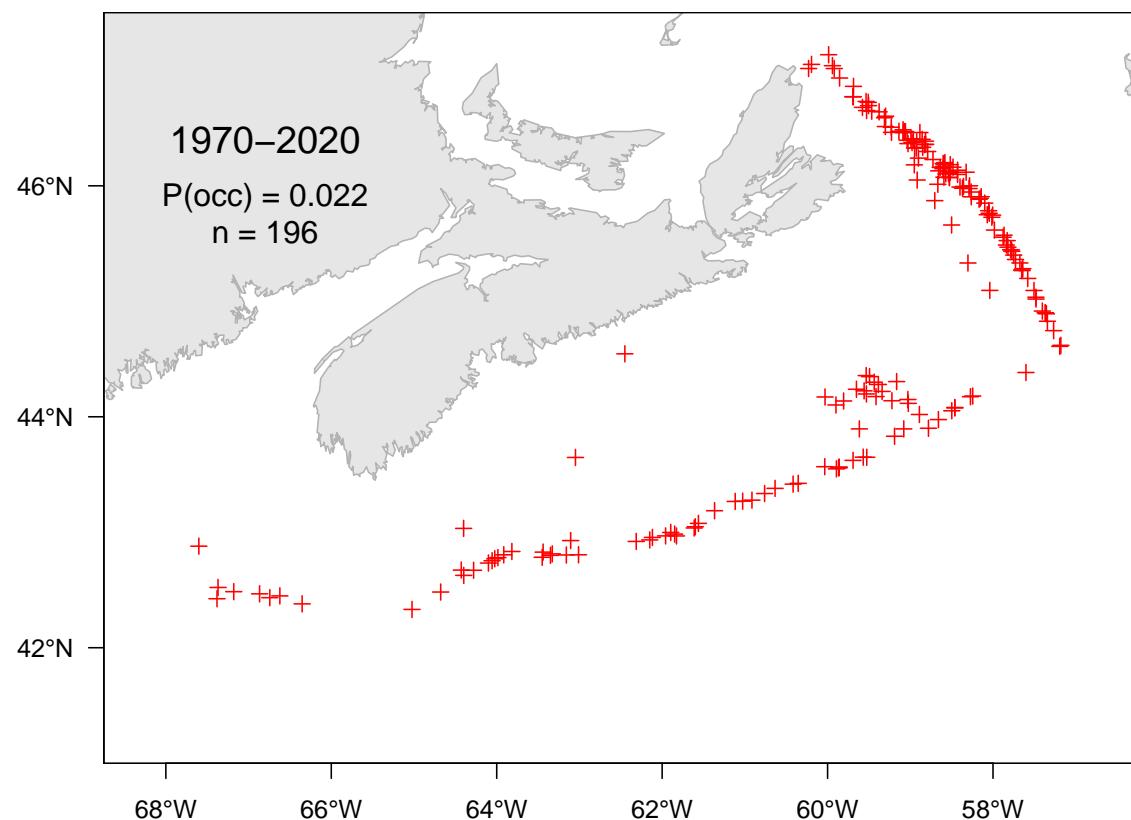


Figure 7.97A. Catch distribution for White barracudina.

1153

### 7.98 Atlantic saury (*Balaou atlantique*) - species code 720 (category LR)

1154

Scientific name: [Scomberesox saurus](#)

1155

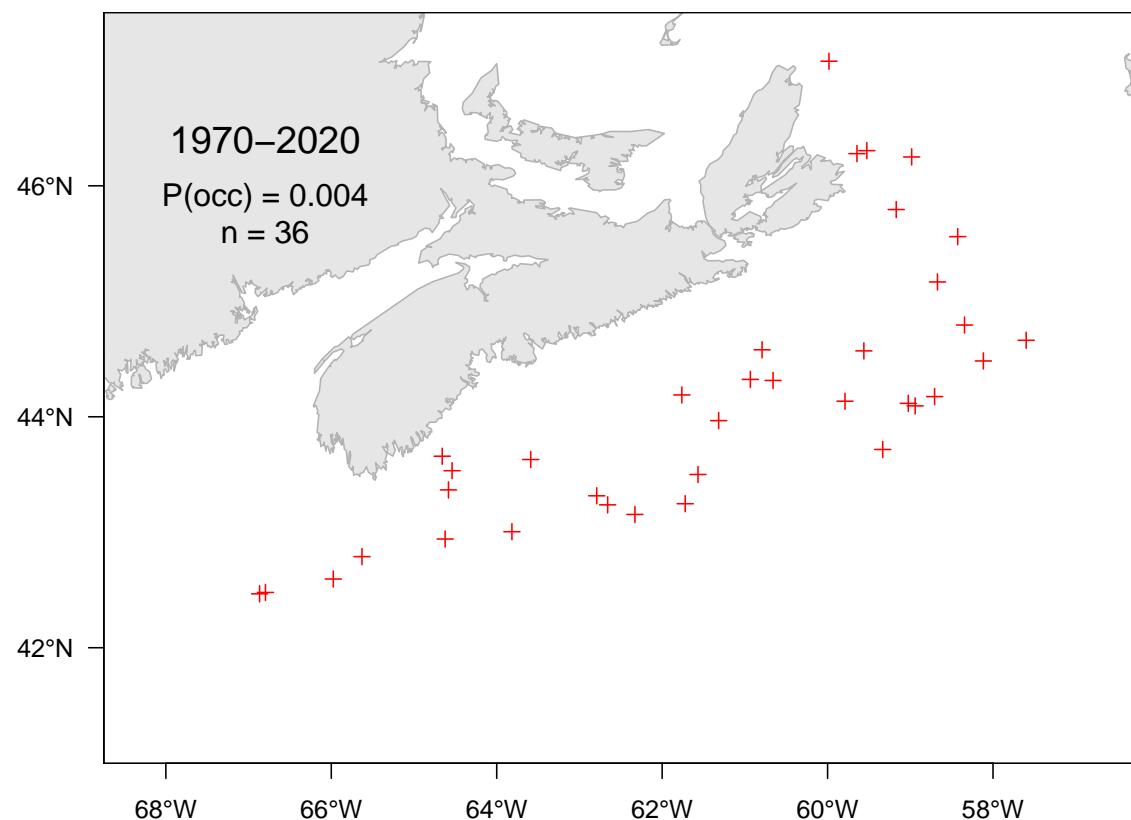


Figure 7.98A. Catch distribution for Atlantic saury.

1156

## 7.99 Hatchetfishes (Haches d'argent) - species code 741 (category LR)

1157

Scientific name: [Sternopychidae](#)

1158

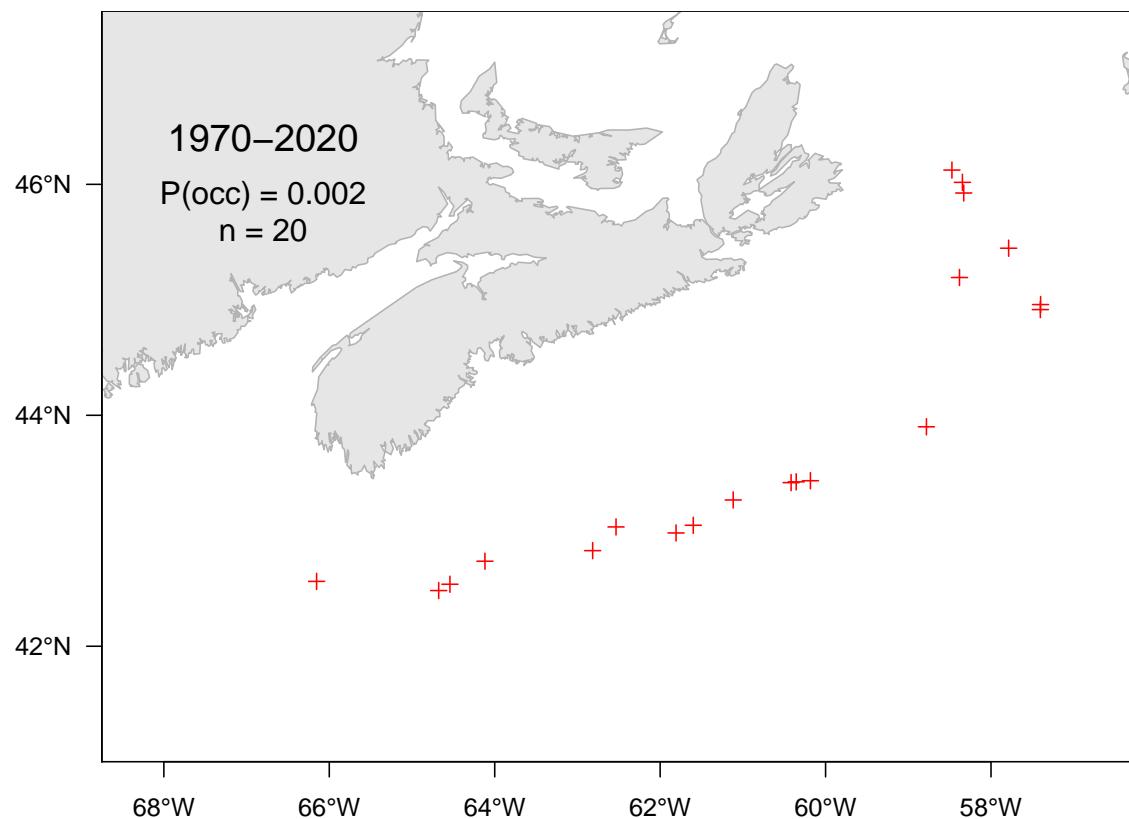


Figure 7.99A. Catch distribution for Hatchetfishes.

1159

## 7.100 Atlantic batfish (*Malthe atlantique*) - species code 742 (category LR)

1160

Scientific name: [Dibranchus atlanticus](#)

1161

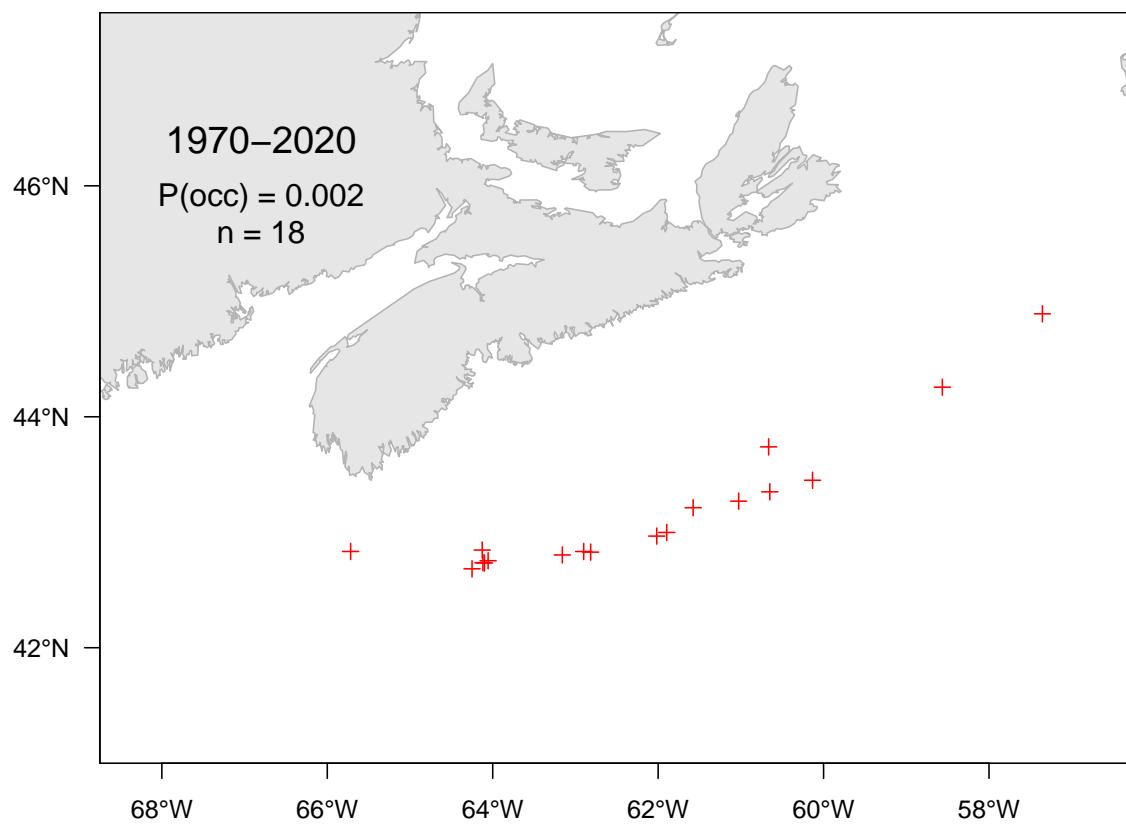


Figure 7.100A. Catch distribution for Atlantic batfish.

1162

### 7.101 Spottedfin tonguefish (Langue fil noir) - species code 816 (category LR)

1163

Scientific name: [Symphurus diomedeanus](#)

1164

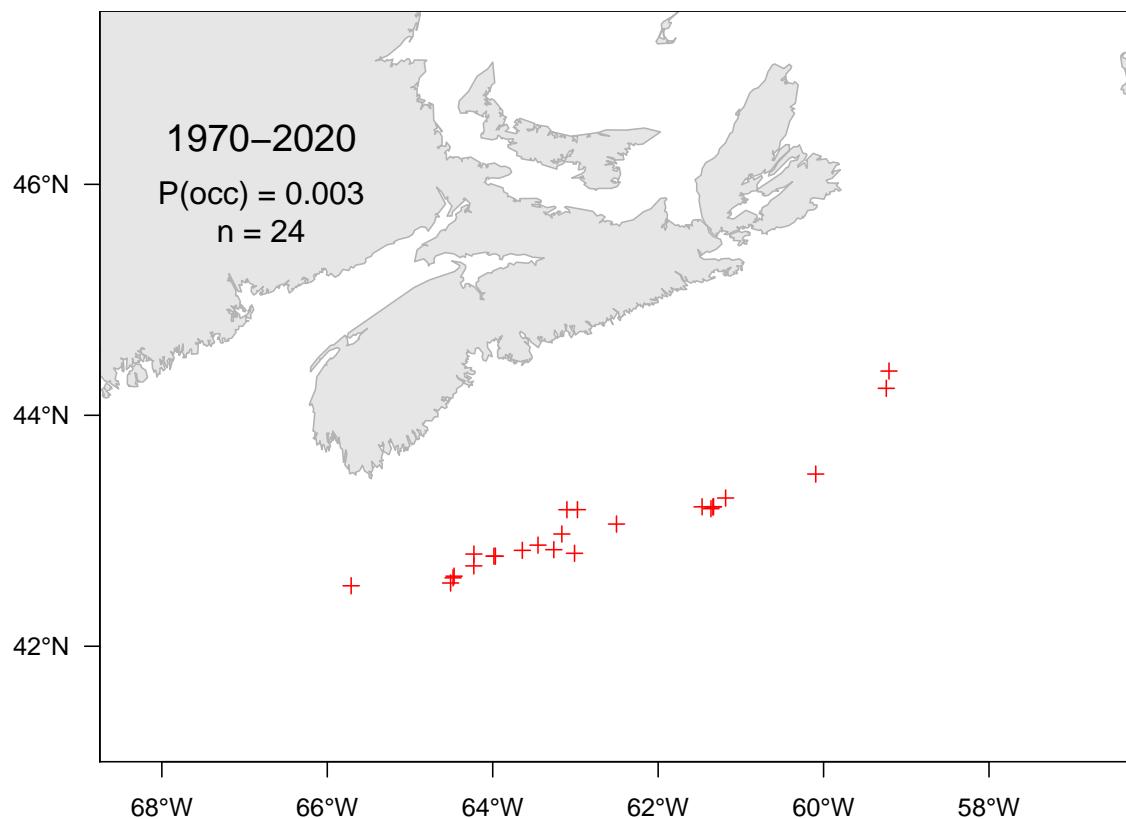


Figure 7.101A. Catch distribution for Spottedfin tonguefish.

1165

## 7.102 Black dogfish (Aiguillat noir) - species code 221 (category LR)

1166

Scientific name: [Centroscyllium fabricii](#)

1167

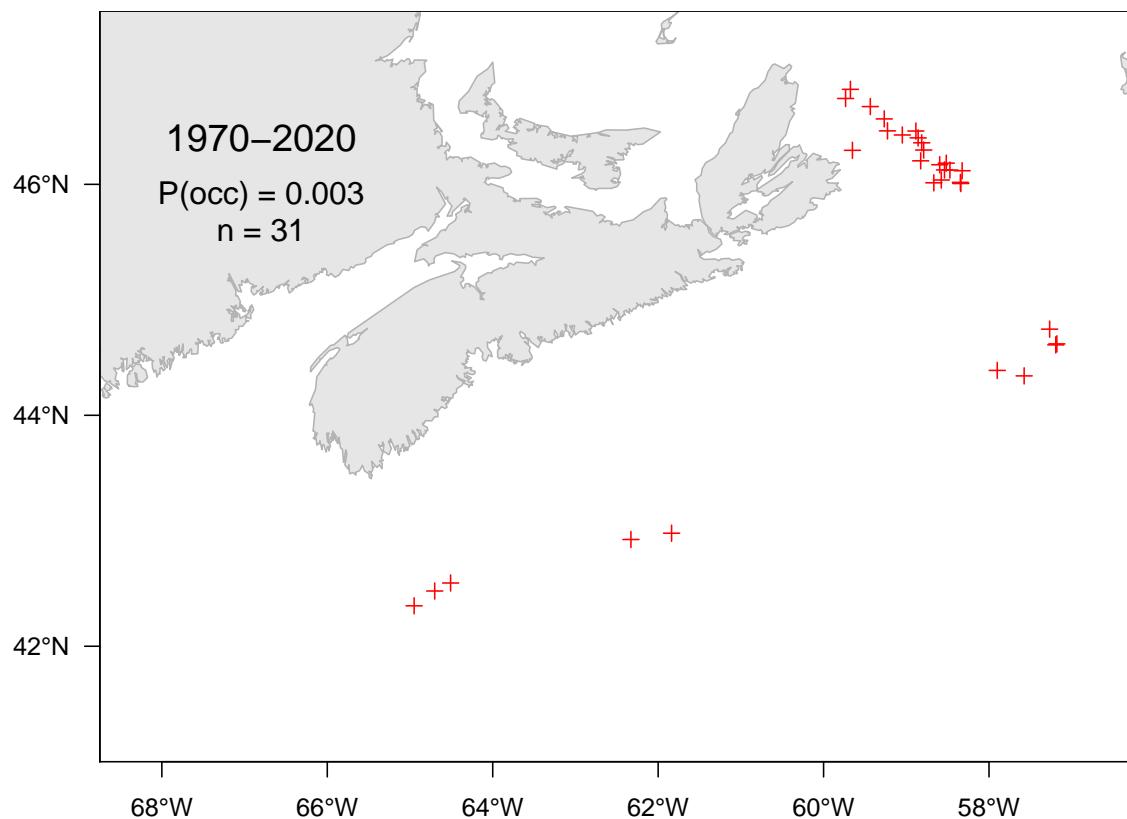


Figure 7.102A. Catch distribution for Black dogfish.

1168

### 7.103 Longfin inshore squid (*Calmar totam*) - species code 4512 (category LR)

1169

Scientific name: [Doryteuthis pealeii](#)

1170

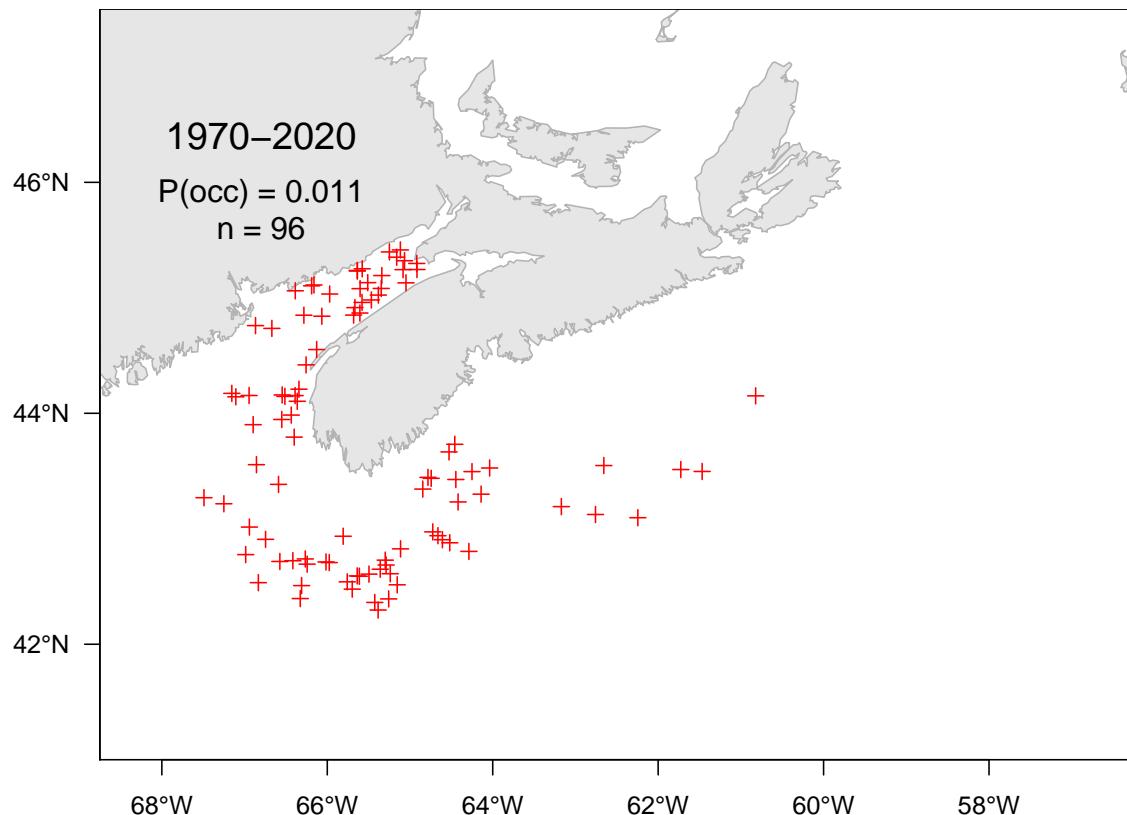


Figure 7.103A. Catch distribution for Longfin inshore squid.

1171

#### 7.104 Red deepsea crab (Crabe rouge) - species code 2532 (category SR)

1172

Scientific name: [Chaceon quinquedens](#)

1173

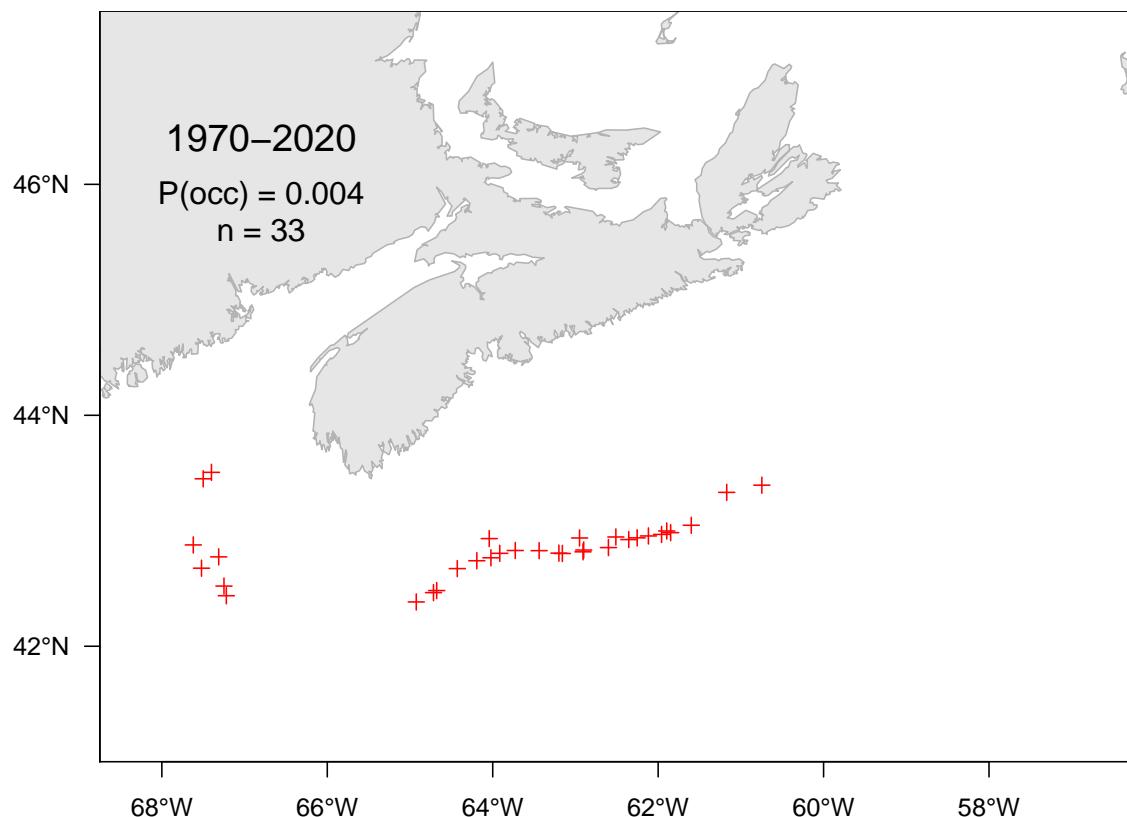


Figure 7.104A. Catch distribution for Red deepsea crab.

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